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BUREAU OF WATER AND WASTEWATER
WATER & WASTEWATER ENGINEERING DIVISION

INTEGRATED PLANNING FRAMEWORK
DRAFT SUMMARY REPORT

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MWH-LBWS JOINT VENTURE

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1 EXECUTIVE SUMMARY

1.1 Integrated Planning Framework Initiative

In late 2011 the U.S. Environmental Protection Agency ("EPA") Headquarters announced an innovative new approach for communities facing large expenditures to meet regulatory requirements for wastewater and stormwater systems. The proposed Integrated Planning Framework ("IPF") is an approach that will enable the City of Baltimore (the "City" or "Baltimore City") and other municipalities and utilities to prioritize projects in ways that achieve utility operation goals as well as regulatory goals.[1]

The IPF is designed to allow communities to implement projects at a schedule that is based on achieving the greatest benefit rather than on a solely regulatory-driven project selection and scheduling process. The EPA's IPF initiative goals are to:

- Maintain existing regulatory standards that protect public health and water quality;
- Allow a municipality to balance various Clean Water Act ("CWA") requirements in a manner that addresses the most pressing public health and environmental protection issues first; and
- Allow the municipality to choose to pursue the IPF approach, which may include developing requirements and schedules in enforceable documents.

EPA initially targeted the IPF approach to the CWA issues of wastewater and stormwater. Through national listening sessions and other areas of feedback, stakeholders such as Baltimore and other municipalities requested the inclusion of drinking water under the Safe Drinking Water Act ("SDWA"). In Baltimore, the City's Department of Public Works Bureau of Water and Wastewater is responsible for drinking water as well as wastewater and stormwater. City residents receive bills for all three services[2] and expect that the Bureau will manage all three services in the most efficient and cost-effective manner possible. Thus, for Baltimore, inclusion of water projects, along with wastewater and stormwater projects, is necessary to provide a holistic IPF analysis.

Through initial discussions on the City's intended IPF approach with EPA and MDE, the agencies agreed to review Baltimore's IPF approach with the water projects included. The City is appreciative of this consideration and this *IPF Draft Summary Report* (the "Draft Report") is reflective of Baltimore's intent and objective to include all three utilities as part of its integrated planning approach.

At present, the City's capital program is largely dictated by which projects are mandated by state and federal regulations or agreements such as the 2002 Wet Weather Consent Decree. While these projects are important, a more balanced approach to utility infrastructure is needed. The City cannot afford to devote such a large portion of available funds to mandated projects to the detriment of other important projects and priorities, as described in this report. Just as important for the City is the impact that rate changes have on the financial well-being of citizens. The importance of the affordability aspects included in this report cannot be overemphasized.

[1] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning*, May 2012.

[2] The Bureau intends to begin billing its state-mandated stormwater remediation fee in July 2013.

Summarized in Section 1.6 and further detailed in Section 7, the consequences of various financial scenarios need to be carefully considered.

The EPA guidance frames the IPF as a "living process" whereby an adaptive management approach is used to revise and update plans and implementation strategies. For Baltimore City, this Draft Report will be revised based on updated capital improvement plans and input from the newly formed Utility Asset Management Division, as well as feedback from the EPA, MDE and other stakeholders.

This Draft Report highlights the impact of various project and funding scenarios on the Consent Decree project schedule. However, the City does not target a specific deadline. This summary report is intended to present the details of the City's IPF process, data analysis, benefits analysis and financial analysis. Ultimately, the City will use the IPF to drive the implementation of the capital, operations and maintenance project schedule.

1.2 Baltimore Infrastructure Condition and Challenges

The City's water, wastewater and surface water[3] infrastructure is described in Section 3 of this report. A description of current utility challenges from the City's perspective is detailed in Section 4. In general, the City has been able to meet regulatory requirements and schedules with the exception of controlling unpermitted discharges from the wastewater collection system. These unpermitted discharges are the basis for the City's 2002 Consent Decree with the EPA and the Maryland Department of the Environment ("MDE"). However, the City faces considerable challenges in coming years to comply with the Consent Decree, complete ENR upgrades to the wastewater treatment facilities, meet Chesapeake Bay restoration regulations, and maintain compliance for water and surface water systems, along with other challenges.

In order to meet future drinking water needs and to properly care for its aging water filtration plants, the City must begin construction on the planned Fullerton Water Filtration Plant ("WFP") in the near future. This new plant will use the Susquehanna River as its raw water source, thus providing additional reliability and source water diversification for the City's raw water supply. The characteristics of the Susquehanna River source will require the Fullerton WFP to use more expensive membrane filtration processes.

The City's water transmission and distribution system consists predominantly of cast iron pipe that is aging and increasingly prone to leaks and breaks. These leaks and breaks cause water loss that is detrimental in terms of water conservation and sustainability efforts and contributes to sediment loads in runoff. Large water main breaks can eventually lead to chlorine and fluoride loads reaching the City's receiving waters. Further, the breaks can result in "boil water" advisories and potentially contribute to public health risks. The current reliance on localized flushing to control color, taste and odor complaints can be only a temporary solution in repeat problem areas where main rehabilitation and replacement would provide a more sustainable, longer term permanent solution.

In order to meet state and federal requirements to assist with restoring the Chesapeake Bay, the City's two wastewater treatment plants are in various stages of design and construction to

[3] The Baltimore City Department of Public Works' Bureau of Water and Wastewater uses the term surface water to denote waters that not only fall as rain, but also include snow melt and any other water discharged onto the ground by human activity. As "stormwater" (or "storm water") is commonly used for the same purpose, the terms "surface water" and "stormwater" are used interchangeably in this report.

incorporate higher levels of nutrient removal. The City's draft Municipal Separate Storm Sewer System ("MS4") permit will require the restoration of 20 percent of the City's impervious area, which should go a long way towards meeting the Chesapeake Bay goals along with other total maximum daily loads ("TMDLs"). This is a very aggressive goal for a largely developed urban area like Baltimore.

The City's current Consent Decree requires the "elimination" of sanitary sewer overflows ("SSOs"). The City is in negotiations with state and federal regulatory agencies to define the required level of protection for wet weather SSO control. While the Consent Decree requires many improvements, rehabilitation and repair to the City's wastewater collection system, the Consent Decree does not require complete replacement. Thus, like the water transmission and distribution mains, the City's sanitary sewers and force mains will continue to age and deteriorate unless a proactive maintenance and replacement system is established.

1.3 Baltimore IPF Model

The City's IPF model was developed as a joint effort of the Bureau of Water and Wastewater (the "Bureau") top level managers and the MWH-LBWS Joint Venture Program Management Team ("PMT") responsible for the City's Wet Weather Compliance Program.

The overall IPF process is illustrated in the schematic in Figure 1.1, duplicated from Figure 5.1 and described in greater detail in Section 5.

Figure 1.1. IPF Process Diagram

The team first compiled a list of Capital Improvement Program ("CIP") projects for the water, wastewater and surface water divisions. The initial list included those projects already identified by the Bureau in its existing CIP project listing. To this base list of CIP projects, the team also added needed projects that had previously not been considered because of funding constraints.

These projects were important for utility efficiency or productivity purposes or were delayed because compliance schedules required other projects to be completed first.

The City recognized that it will undertake infrastructure capital and O&M activities in addition to its portfolio of CIP projects. The CIP list only covers six years and does not consider all long-term capital and O&M utility infrastructure needs of the City. Therefore, a list of 27 capital and O&M projects that the City is currently planning, at a total cost of approximately $250 million (in $FY13 dollars) has been identified (see Table A.5 in Appendix A). The City's IPF incorporates the assumption that the annual cost of these capital and O&M projects is representative of continuing capital and O&M projects in the future. Therefore, the same dollar amount of capital and O&M projects (adjusted for inflation) has been included in the IPF for FY19 through the end of the planning period and is referred to in this report as "recurrent capital and O&M expenditures".

As shown in Table 1.1, the IPF Project List totaled 556 projects. To reduce the number of projects to a manageable level, the projects were "bundled" so that the separate study, planning, design, and construction components of the same project were included as one IPF Project. Similar projects in the same watershed, or sewershed that accomplished the same goals were also bundled as one IPF Project. The bundling process reduced the IPF Project List to 153 projects. It is expected that over time additional needs will be identified and refined information will become available, resulting in revisions to the IPF Project List as projects are modified, added or removed as necessary.

Table 1.1. Baltimore IPF Project List Summary

Bureau Section [1]	Total Number of Projects	Bundled Number of Projects	Estimated Cost [2] (million dollars)
Water Facilities	176	46	$ 1,858
Water Utilities	114	18	1,222
Wastewater Facilities	137	35	1,592
Wastewater Utilities	84	16	1,172
Surface Water Facilities	33	26	208
Surface Water Utilities	12	12	316
Totals	**556**	**153**	**$ 6,368**

[1] Infrastructure facilities under the direction of each of the six Baltimore City Bureau of Water and Wastewater Sections are listed in Table 3.1 of this report.

[2] Includes recurrent capital and O&M project costs.

The team used a modified Triple Bottom Line ("TBL") benefit analysis, referred to in this document as a Quadruple Bottom Line ("QBL") analysis, to evaluate the benefits associated with each of the bundled projects. The QBL added "Project Delivery" as the fourth category to the TBL environmental, social and economic categories. The QBL analysis included quantification of the benefit categories shown in Table 1.2.

Table 1.2. Baltimore IPF Benefits Evaluated

Environmental	Social	Economic	Project Delivery
Pollutant Loading to Receiving Waters – Pathogens	Health and Safety	Alternative Funding	Service Life/Condition
Pollutant Loading to Receiving Waters – Phosphorus	Recreational Access	Annual O&M Costs	Project Delay
Pollutant Loading to Receiving Waters – Nitrogen	Urban Tree Canopy	Job Stimulus	Collaboration
Pollutant Loading to Receiving Waters – Sediment	Customer Satisfaction	Capital Costs	
Pollutant Loading to Receiving Waters – Trash	Drinking Water Quality		
Regulatory	Lower Income or Blighted Areas		
Habitat Preservation and Restoration			
Drinking Water Conservation and Control			

Each project was scored with respect to each benefit. Wherever possible, the scores were based on benefit calculations in quantitative terms. Scores were either data-based scores or scale-based scores. The type of scoring for each benefit category is listed in Table 5.3 of this report.

Following establishment of individual bundled project scores, the scores were “balanced” to allow each of the water, wastewater and surface water division projects an equal opportunity to score. That is, scores were balanced across all four QBL categories so that the maximum possible score for any project type across all four categories is equal. The balancing process includes a multiplication formula to equalize the maximum possible score in each QBL category.

Once the scoring and the balancing were completed, the team completed a pairwise comparison to develop importance weighting values. Identifying an appropriate set of importance weighting factors is a critical aspect of prioritization efforts. Each change to the importance weights has the potential to result in a different prioritized project list and project implementation schedule. It is expected that over time the importance weighting factors will be reviewed, revisited and adjusted as needed thus allowing the IPF model to be used on a continual basis.

Importance weights were used to develop three primary project scenarios. These three scenarios include:

- **Scenario 1,** Baltimore IPF Scenario. The City's recommended Capital Improvement Plan ("CIP") projects, recurrent capital and O&M projects, and other projects including water, wastewater and surface water based on City-defined needs and budget constraint schedules.
- **Scenario 2,** EPA IPF Scenario. A selection and prioritization process for CIP projects, recurrent capital and O&M projects and other projects for wastewater and surface water projects only.
- **Scenario 3,** Regulatory Scenario. This scenario functions as the baseline scenario as it is modeled to reflect current conditions (i.e., the "status quo") where regulatory considerations substantially drive project prioritization to the exclusion of other considerations.

Scenarios 1 and 2 are essentially the same scenario except that Scenario 2 deletes the water projects covered under the SDWA. For these two scenarios, the importance weight factors were developed according to City preferences regarding which benefit criteria are important, more important and most important. In Scenario 3 the importance weight factors were developed to weight the regulatory-related evaluation criteria much higher. Thus, Scenario 3 represents the conditions where regulatory considerations are the primary (but not entire) drivers for which projects get prioritized.

Figure 1.2 presents the relative importance weightings for these scenarios (these figures are presented in a larger format in Figure 6.3 and Figure 6.4 presented in Section 6 of this report.).

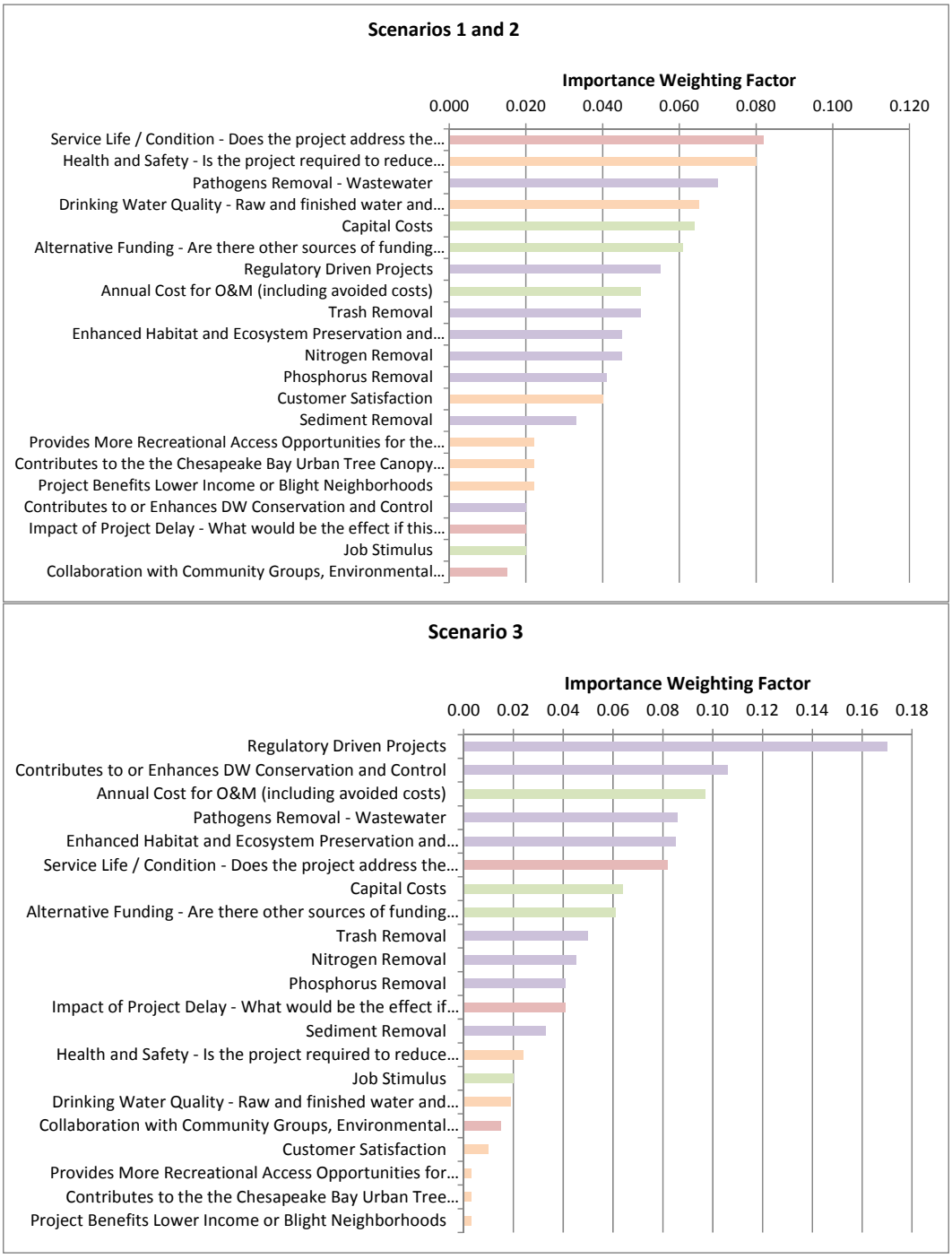

Figure 1.2. Scenario Weighting Importance Comparison

Based on the IPF Project List scores and importance weighting, a prioritized list of projects ranked in order of total weighted score was generated. Appendix D presents the prioritized lists resulting from the identified scenarios. The projects are color coded according to the type of project including water facilities ("WF"), water utilities ("WU"), wastewater facilities ("WWF"),

wastewater utilities ("WWU"), surface water facilities ("SWF") and surface water utilities ("SWU").

1.4 IPF Prioritization and Schedule Results

While a prioritized list is useful for the City to gauge which projects are expected to bring the most benefit, it does not factor in project cost, project dependencies, constructability issues, or other scheduling considerations. The City utilized a project scheduling model that factors in both project and financial considerations to optimize its infrastructure investments. It takes financial and scheduling constraints as inputs and optimizes project scheduling to provide the greatest QBL benefit over a 20-year planning horizon. The IPF project scheduling model was used to create the project schedule for Scenario 1. Specific constraints of the scheduling model are explained in Section 6.4.

The City created three financial alternatives, or sub-scenarios, by which to evaluate Scenario 1. The sub-scenarios (Scenarios 1A, 1B and 1C) included key financial assumptions such as a 3 percent inflation rate by which costs past FY13 are escalated as appropriate. Total costs were spread evenly over the estimated project duration in line with the City's common financial modeling practice. Likewise, a 3 percent benefit discount rate was applied to incentivize projects being started and executed in early years of the planning period. While each sub-scenario considered the same portfolio of projects, the sub-scenarios differed in the annual available funding limit, whether are able to be deferred beyond the planning period, and the annual dollar amount reserved for annual recurrent capital and O&M projects. In all three sub-scenarios, annual recurrent capital and O&M projects were scheduled to begin at the end of the CIP planning period in FY19.

The three sub-scenarios are compared with the Scenario 3, Regulatory, which consists of all projects as currently scheduled. The model assumption for this scenario is that under the status quo situation, the Consent Decree projects will be complete in FY23. The project scheduling model was not used in the Regulatory Scenario case as all project start and end dates are set.

In Scenario 1A, all capital projects must be completed within the 20-year planning period and annual recurrent capital and O&M projects are expected to cost the City $250 million a year in FY13 dollars. The funding ceiling was set at $320 million in FY13 dollars, which is the lowest possible level that allows all projects to be completed and all model constraints to be satisfied.

Scenarios 1B and 1C reflect scenarios with lower annual available funding limits than Scenario 1A. To reduce annual spending, annual recurrent capital and O&M expenditures must be reduced, capital projects must be deferred beyond the study period, or both.

Scenario 1B caps annual spending at $250 million in FY13 dollars while reducing annual recurrent capital and O&M expenditures to $210 million in FY13 dollars. Capital projects may be deferred beyond the study period in Scenario 1B.

Scenario 1C caps annual spending at $250 million in FY13 dollars while reducing annual O&M expenditures to $170 million in FY13 dollars. Capital projects may not be deferred beyond the study period in Scenario 1C.

While Scenario 1B allows the possibility for capital projects to be deferred beyond the study period, the PMT identified a list of "mission critical" projects that are necessary for utility operation and may not be deferred. The list of projects considered "mission critical" is currently under review by the City and will be revised as needed as part of future IPF updates.

In each of the scenarios evaluated, the annual expenditures represent *only the City's share* of the capital program budget. When the infrastructure investment accounts for Baltimore County's share and other funding sources are added with the City's infrastructure share, the utility infrastructure investment program amounts to more than $500 million per year. This draft report bases its preliminary analyses on City expenditure considerations only.

Table 1.3. Comparison of Model Inputs

Scenario	Annual Spending Limit	Annual Recurrent[4] Project Expenditures (FY19 and beyond)	Unconstrained Projects Deferred?
Regulatory	N/A	$250 million	No
Scenario 1A	$320 million	$250 million	No
Scenario 1B	$250 million	$210 million	Yes
Scenario 1C	$250 million	$170 million	No

All dollar amounts listed in FY13 dollars

Key model outputs, including the average expenditure per year in FY13 dollars, the number of capital projects deferred past the planning period, and the year of last Consent Decree project completion, are shown in the Table 1.4.

Table 1.4. Comparison of Model Outputs

Scenario	Average Spend per Year	Number of Capital Projects Deferred Past FY32	Consent Decree Completion
Regulatory	$275 million	None	FY23
Scenario 1A	$283 million	None	FY30
Scenario 1B	$229 million	18	FY32
Scenario 1C	$225 million	None	FY28

All dollar amounts listed in FY13 dollars

Projected annual spending by project type for all scenario outputs is shown in the cost histograms, Figures 1.3 through 1.6. Annual expenditures are color coded by project type. The dollar amounts shown in the cost histograms are in nominal terms – the bar in FY32 expresses the cost in FY32 dollars while the bar in FY13 is in FY13 dollars. The cost histograms[5] also show the year of last Consent Decree project completion according to the schedule generated by the model and the average annual cost, converted into real (FY13) dollars.

4 "Recurrent projects" refers to the City's projected yearly capital and O&M needs beyond the current six-year CIP period.

5 Approximately $300M of recurring annual O&M projects are scheduled to begin in FY19 (this is equivalent to $250M in FY13 dollars assuming a 3% inflation rate). To stay below the cost ceiling in FY19, few capital projects can be started in the years immediately prior. As a result, FY18 spending is reduced considerably.

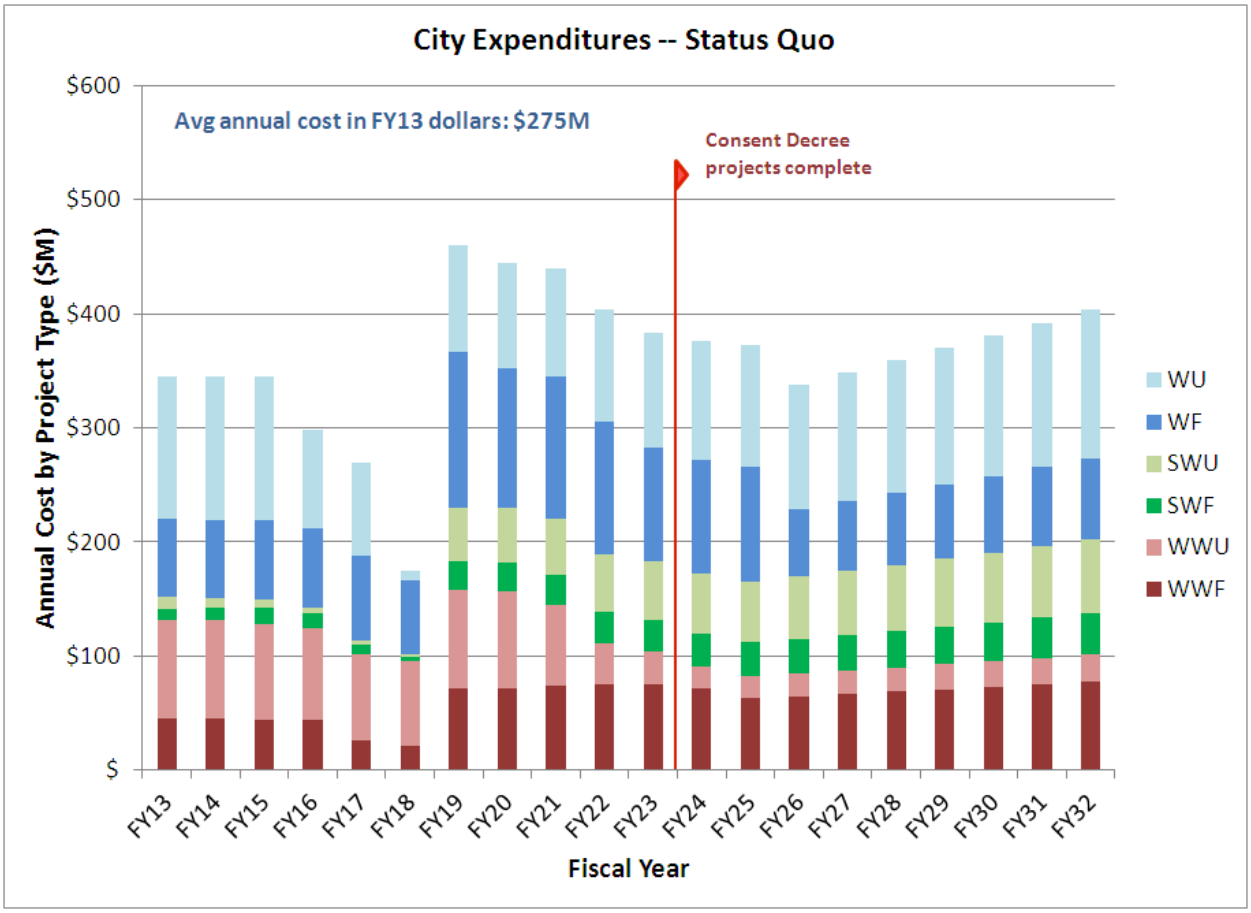

Figure 1.3. Project Annual Spending – Scenario 3, Regulatory (Status Quo)

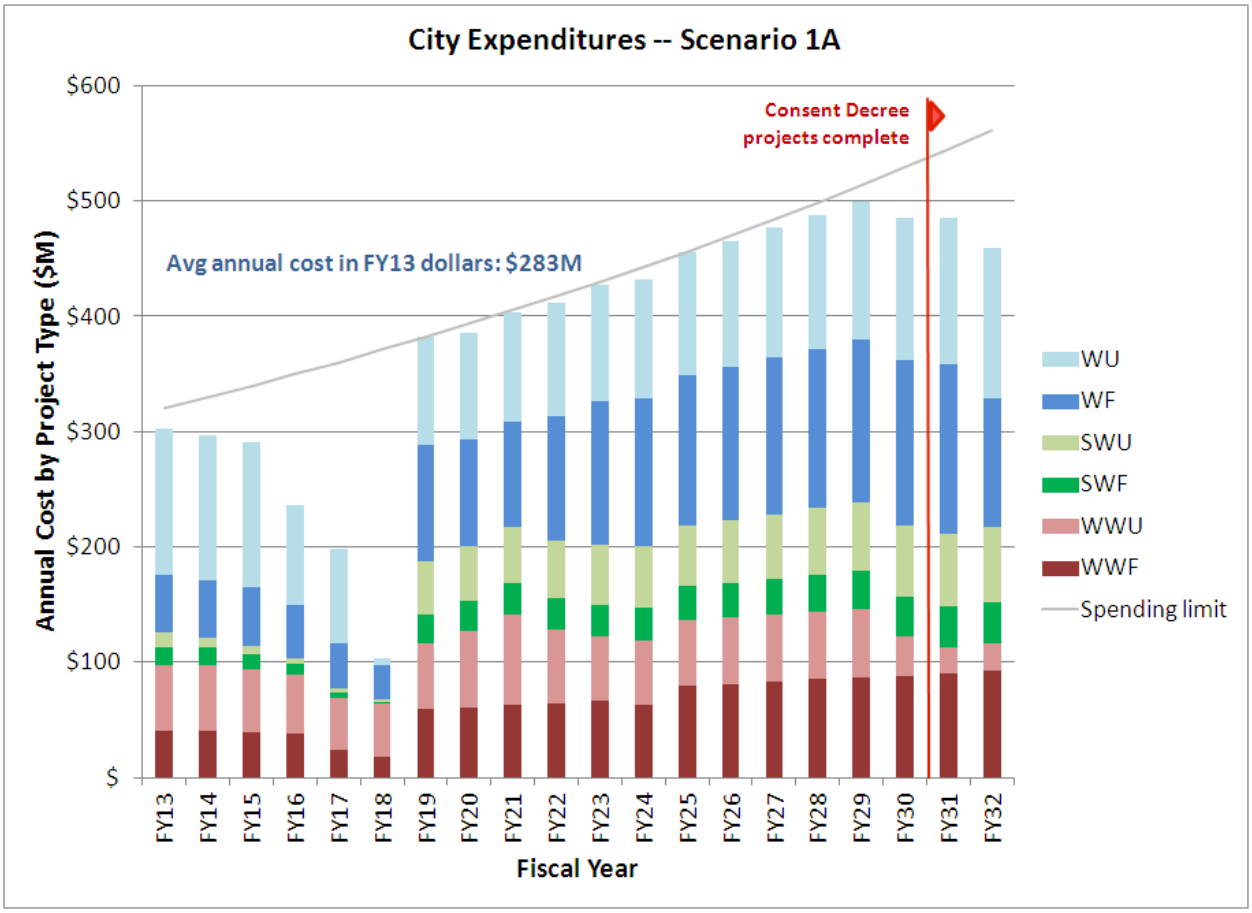

Figure 1.4. Project Annual Spending – Scenario 1A

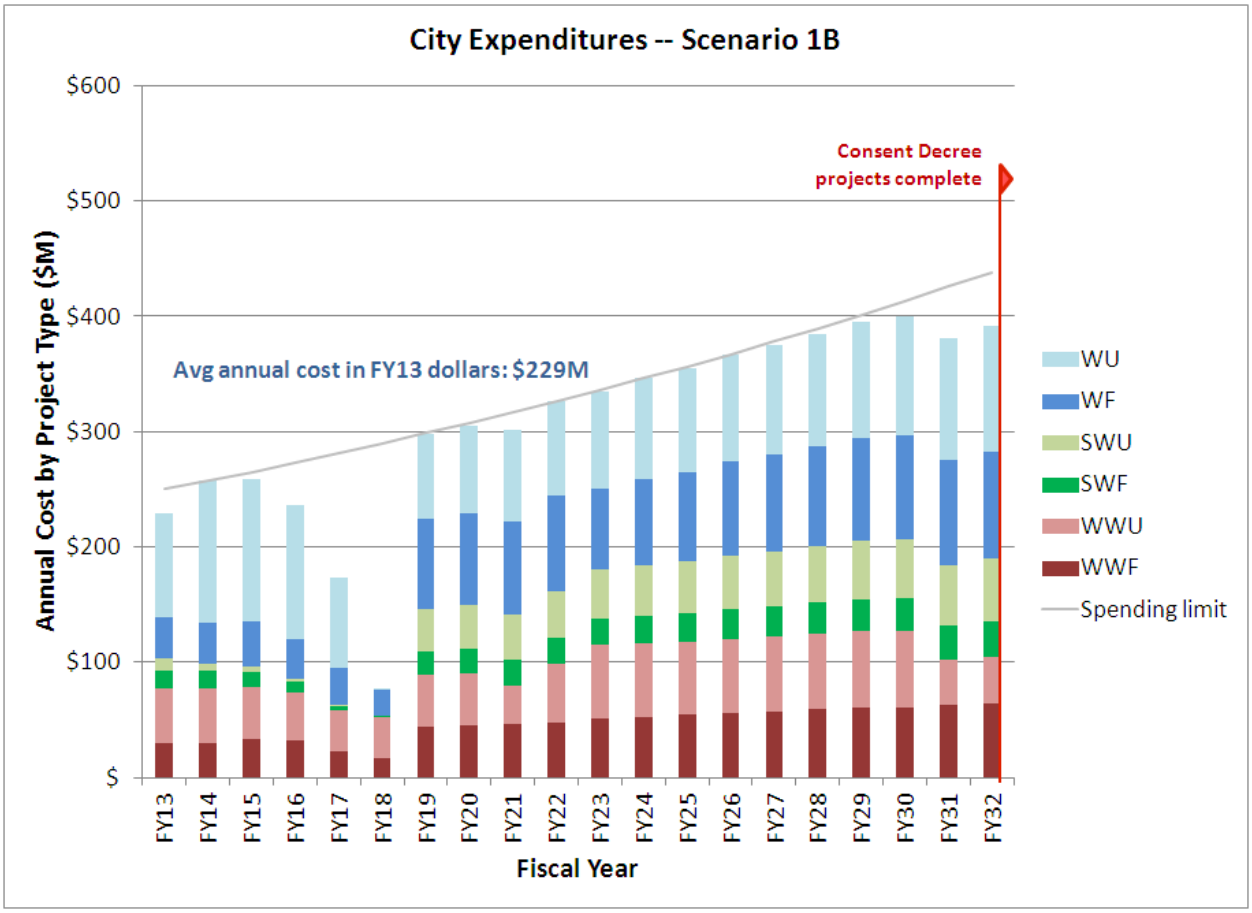

Figure 1.5. Project Annual Spending – Scenario 1B

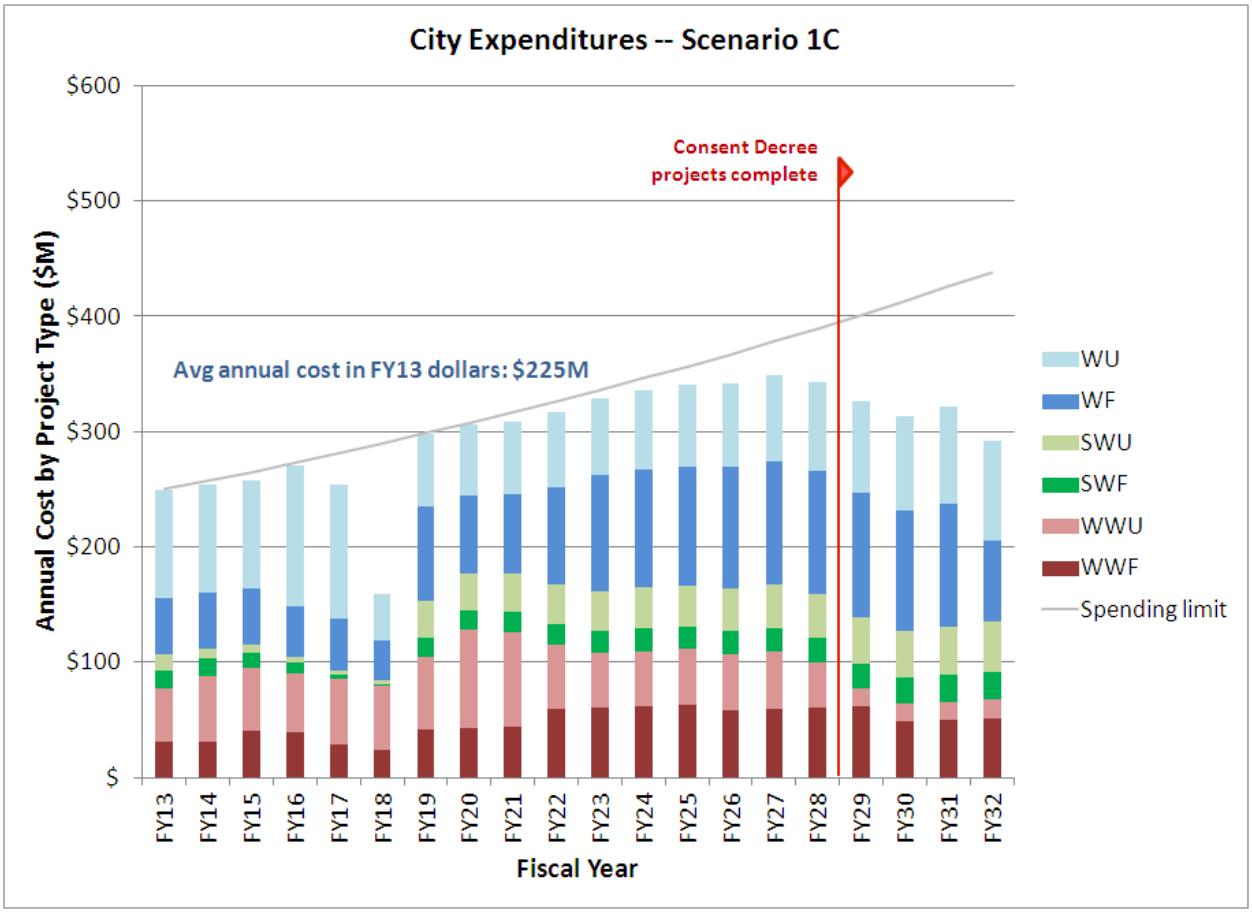

Figure 1.6. Project Annual Spending – Scenario 1C

1.5 Benefits Distribution Analysis

Each project scenario schedule results in a specific allocation of benefits. The Benefits Distribution Analysis discussed in Section 6 calculates how the QBL benefits are temporally distributed within the portfolio of projects for each scenario. This analysis allows for an understanding of how the different project scenarios impact the timing of total benefits delivered. In general, benefits were classified as recurring benefits or one-time benefits. Section 6 describes the methodology used to define the distribution of benefits for the 21 QBL criteria.

Figure 1.7 shows the annual benefit score for the Regulatory Scenario, and the three financial alternative sub-scenarios (Scenarios 1A, 1B and 1C) for comparison. The sub-scenarios show an earlier realization of benefits than the Regulatory Scenario. This is a preliminary analysis and future IPF efforts will include additional examination of how the movements of individual projects within the portfolios impact the benefits distribution.

It is also important to note that several IPF projects associated with ongoing operations and maintenance have been included in the results, but these projects have not yet been scored in all evaluation criteria categories. After these projects have been fully scored, benefits are expected to increase overall. It is also expected that the shape of the curve would become

smoother, as the annual recurrent capital and O&M projects are modeled to start in 2019. The City's new Utility Asset Management Division ("UAMD") initiative will define and identify these annual recurrent capital and O&M projects more fully and their associated benefits and costs. As the City's new UAMD takes form, the IPF project information, costs, and benefits will be updated accordingly. It is understood that funding invested in proactive asset management and recurrent annual capital and O&M efforts will have a lag time before benefits start to accrue and be realized.

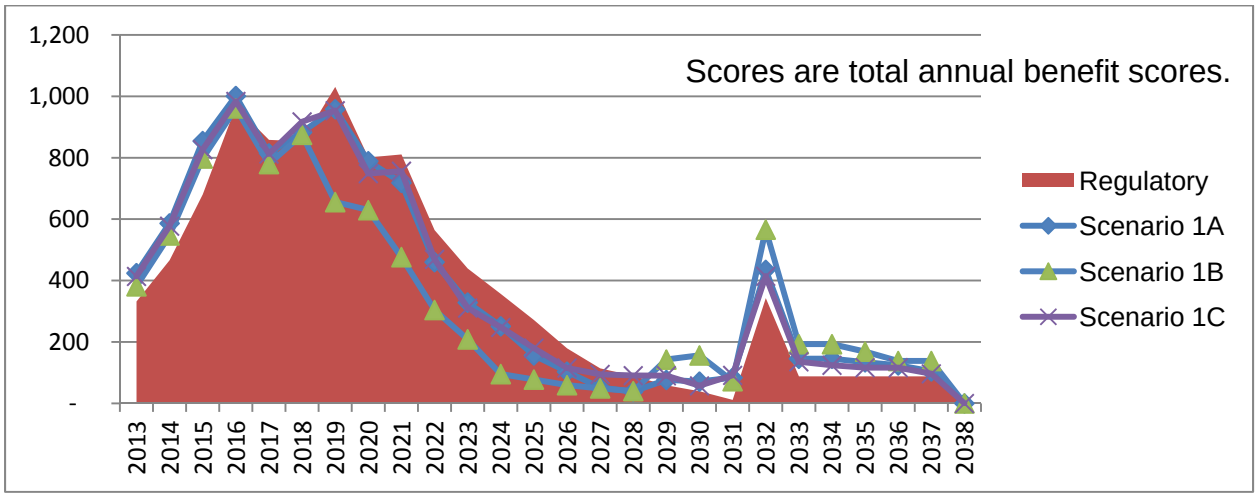

Figure 1.7. Total Annual Benefit Score

1.6 Financial Analysis and Customer Impacts

A key component of the City's IPF effort involves incorporating the results of the project prioritization and weighting activities with the City's financial planning model to determine the impacts of the proposed scenarios on the Bureau's financial planning and on customer rates. The financial analysis is discussed in Section 7. Two versions of the financial planning model were developed for analyzing the IPF prioritized project list.

- The first version of the financial model is based on the assumption that the proposed capital projects would be fully funded according to the current schedule and spending rate as prepared by the PMT (this is referred to as the "Regulatory Scenario" and is essentially the current situation or status quo). The Regulatory Scenario projects annual capital investment of approximately $275 million annually (in present value dollars) for total capital spending of $5.5 billion by FY32. Rates were adjusted as needed to meet the requirements of the full capital costs.
- The second version of the financial model assumes the City will invest approximately $229 million annually in its capital program for a total of approximately $4.5 billion in capital investment by FY32 (this is referred to as "Scenario 1B" as described in Section 6.4.4. Rates were adjusted as needed to meet the requirements of the full capital costs).

In 1997, the EPA developed a two-phased approach to assess the financial capability of municipalities and serve as guidance in determining appropriate implementation schedules for the capital improvements required to address combined sewer overflow (CSO) problems under its Control Policy. Median household income (MHI) has been used as a central component of EPA affordability measures for more than 10 years; however the MHI standard is met with objections from utilities and industry associations alike. The National Association of Clean Water Agencies ("NACWA") recently published a white paper declaring "the federal government's use of an area-wide MHI cannot accurately assess the impacts on this sensitive community population[6]" and "use of a median value by definition mutes consideration of important diversities across a permittee's served population." The City believes that EPA's guidelines for determining the Residential Indicator do not give full consideration to income distribution within a population and that an alternate approach is warranted.

The City had an MHI of $39,386 according to the 2010 US Census, which was an increase of 31 percent from the 2000 Census data.[7] Looking beyond just the city-wide MHI provides insight into how potential water and sewer costs will impact the full spectrum of utility customers, including seniors and low-income households. Approximately 26.2 percent of the City's population lives below the federal poverty line and approximately 12.3 percent of the City's population lives below half of the federal poverty line. Figure 7.1. Income Distribution shows the income distribution of City residents as a whole. It is clear that while the City-wide MHI may be $39,386, a large percentage of customers have significantly lower income levels.

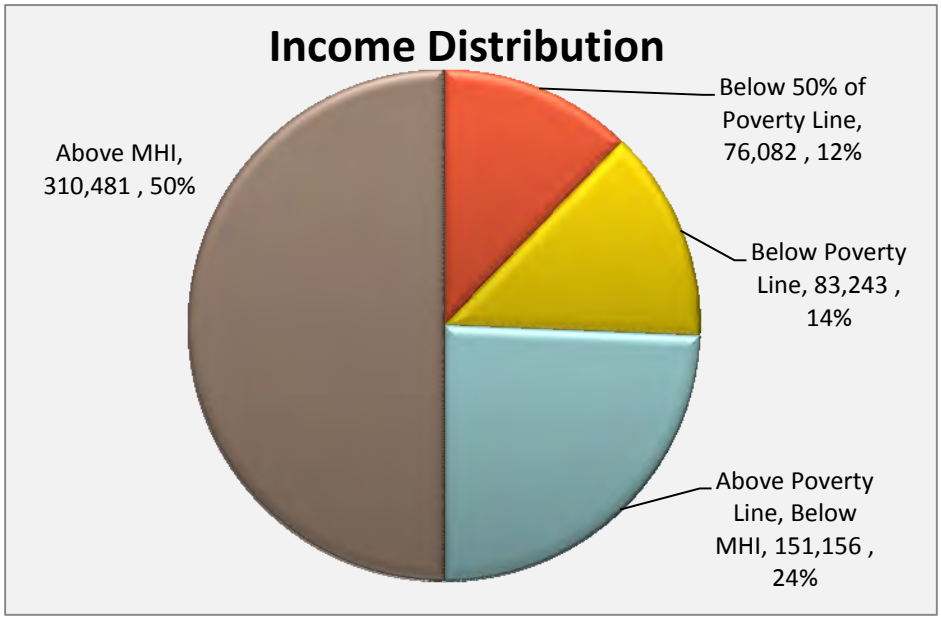

Figure 1.8. Income Distribution

Baltimore City demographics illustrate a flaw in simply using service area MHI as a key indicator in determining affordability. The City compiled results from the 2010 US Census to examine how income levels were distributed within City limits. Figure 7.2. Baltimore City Income Distribution presents the percentage of households at each income increment and Figure 1.10.

[6] *Financial and Capability and Affordability in Wet Weather Negotiations*, NACWA, CHM2Hill, October 2005.
[7] U.S. Census Bureau, *American Fact Finder*, (2010, 12 1).

Cumulative Baltimore City Income Distribution presents the cumulative percentage of households at each income increment. It is important to note the ranges are larger at higher income levels.

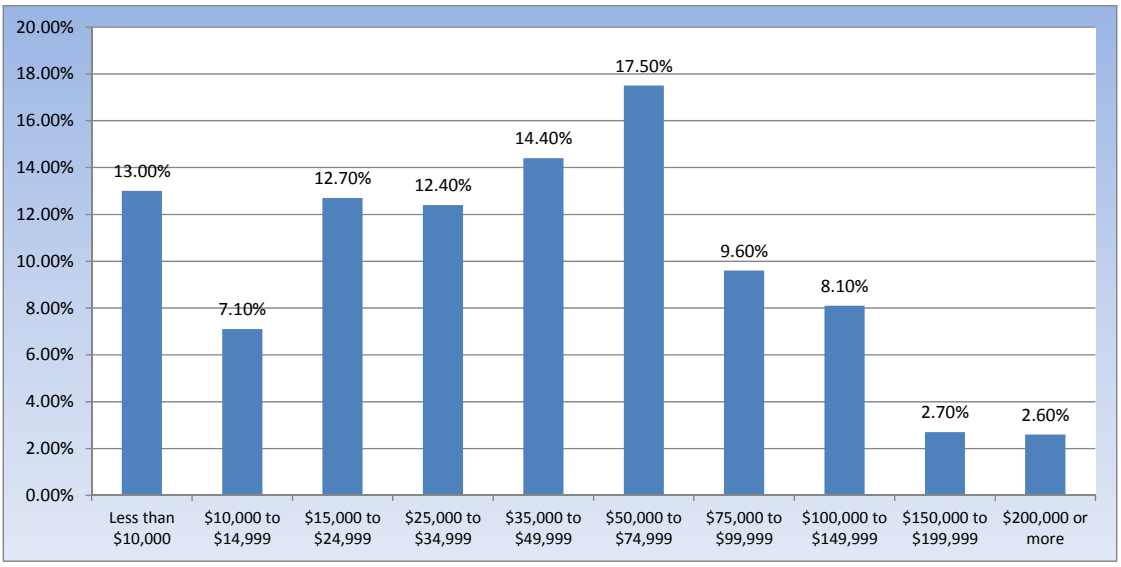

Figure 1.9. Baltimore City Income Distribution

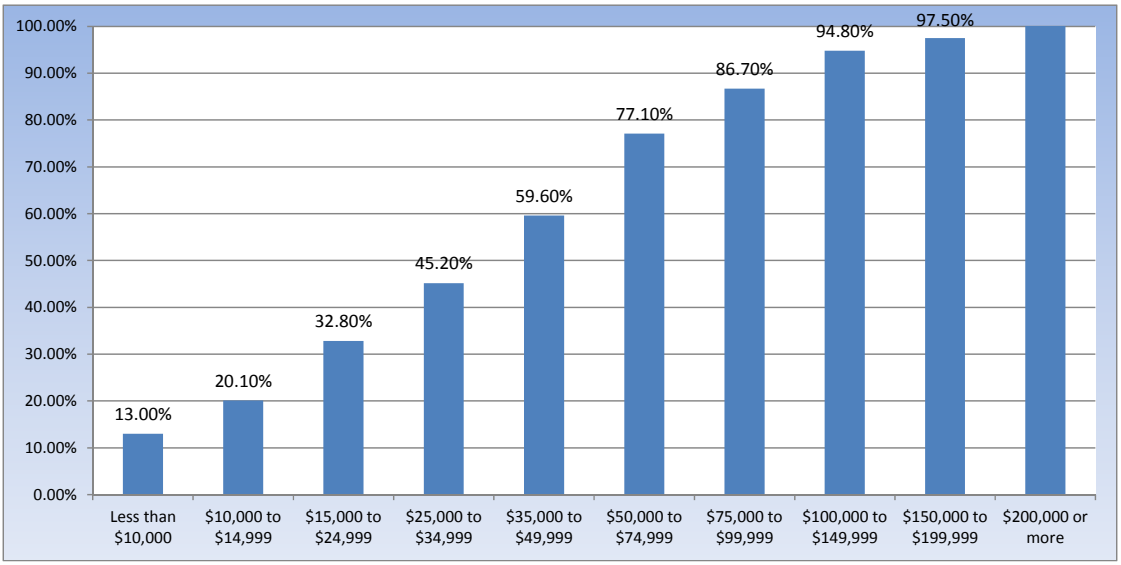

Figure 1.10. Cumulative Baltimore City Income Distribution

Analysis of the service area income distribution shows that household incomes are not normally distributed around the center median. There is a large percentage of households with very low income levels, and a very long tail of high income households. Assuming $30,000 for annual household income would set the tipping point for determining unaffordable utility costs at the 39th percentile of City household incomes. The City believes this is more appropriate than the citywide MHI due to its residents' demographics and income distribution.

1.6.1 Regulatory Scenario Results and Customer Impacts

Meeting the capital financing requirements of the Regulatory Scenario requires the City to increase water and sewer rates beyond 9 percent annual rate increases, which have been the norm for the last decade. During this same time span, a typical family of four has seen the costs of their water and sewer bill triple. The projected capital funding needs are met by a mixture of long term debt (revenue bonds) and revenue funded capital (PAYGO). Future rate increases are determined by the requirements to meet the operating cash needs of the system and maintain the City's debt coverage at policy-defined levels. Section 7 presents the needs and proposed financing sources for the utilities over the planning period.

The cumulative impact of the increases on the water rates between FY13 and FY24 is projected to be greater than a 146 percent increase and for wastewater rates is projected to be greater than a 99 percent increase.

To determine customer impacts and affordability, the annual rate increases were applied to the current water and sewer rates. The projected rates were then used to calculate quarterly (and annual) water and sewer bills for typical customers and analyzed at two quarterly usage levels:

- City design-based standard for a family of four, 39 hundred cubic feet ("ccf") or approximately 29,200 gallons per quarter.
- Residential customer average usage, 21 ccf or approximately 15,700 gallons per quarter.

A flat quarterly stormwater charge was also included in the residential customer's annual cost calculation. Projected residential customer rates and detailed customer impact information are included in Appendix F.

The customer impacts from the Regulatory Scenario approach show the following outcomes:

- Customer's annual water and sewer costs will increase by approximately 277 percent by FY30.
- Assuming 39 ccf (Baltimore design-based standard for family of four) of quarterly water consumption:
    - Annual water and sewer costs become unaffordable in FY15 (4.1 percent) and represent 7.6 percent of City-wide MHI in FY30.
    - Annual water and sewer costs are unaffordable in FY13 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 10.2 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs are unaffordable for 28 percent of the City's census tracts in FY13 (representing approximately 23 percent of the City's population). By FY23, water and sewer costs would be classified as unaffordable for 90 percent of the City's census tracts (87.5 percent of the City's population).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs are already unaffordable. Customers spend approximately 6.8 percent of their income on water and sewer

in FY13; this increases to approximately 17 percent of their annual income on water and sewer by FY30.
    - This group includes 25% of families with children under five years old.
  - 39 percent of all households are spending 4.1 percent of annual income on water and sewer costs in FY13.

- Assuming 21 ccf (residential average) of quarterly water consumption:
  - Annual water and sewer costs represent 4.0 percent of City-wide MHI by FY26.
  - Annual water and sewer costs become unaffordable in FY16 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 6.8 percent of annual income for 39% of households in FY30.
  - Annual water and sewer costs become unaffordable for 53 percent of the City's census tracts by FY23 (representing approximately 47.7 percent of the City's population).
  - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs represent 3.8 percent of income in FY13. Customers will spend approximately 9.5 percent of their annual income on water and sewer by FY30.
  - The annual water and sewer costs are already unaffordable for the 77,000 people currently living below 50 percent of the federal poverty line, and account for nearly 8 percent of their income.
  - 27 percent of all families will be spending 4.4 percent of annual income on water and sewer costs in FY16.
- These results are summarized in Figure 1.11**Error! Reference source not found.**, Figure 1.12, Figure 1.13, Figure 1.14, Figure 1.15, and Figure 1.16. Figure 1.13 and Figure 1.16 are maps depicting the City's census tracts and their unique affordability status at the end of the forecast period. A red census tract district is unaffordable based on its individual MHI.

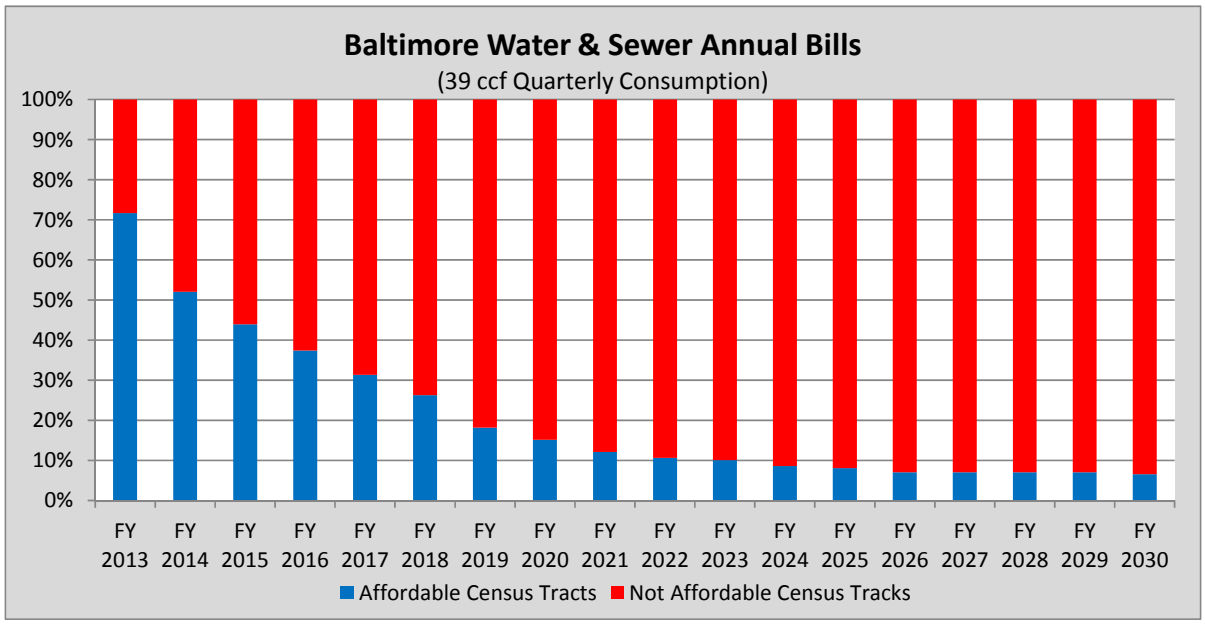

Figure 1.11. Status Quo Water and Sewer Affordability at 39 ccf/quarter

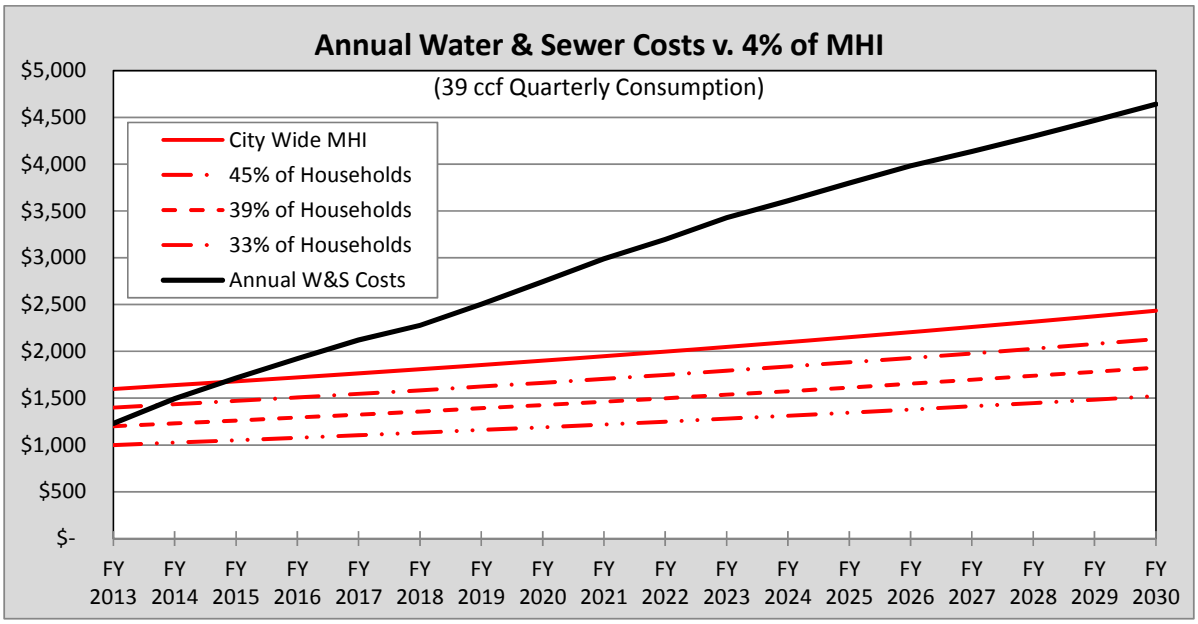

Figure 1.12. Status Quo Costs Compared to 4% of MHI for Population Percentages

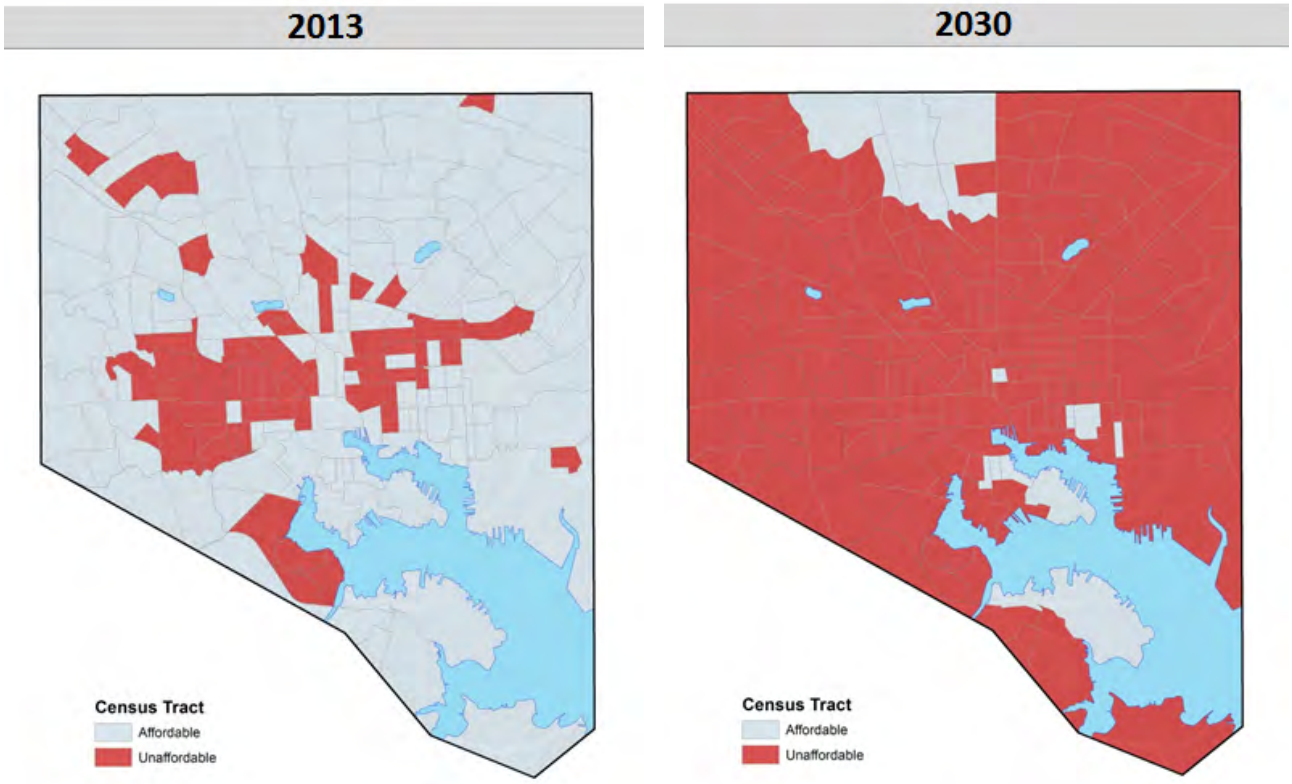

Figure 1.13. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Regulatory Scenario

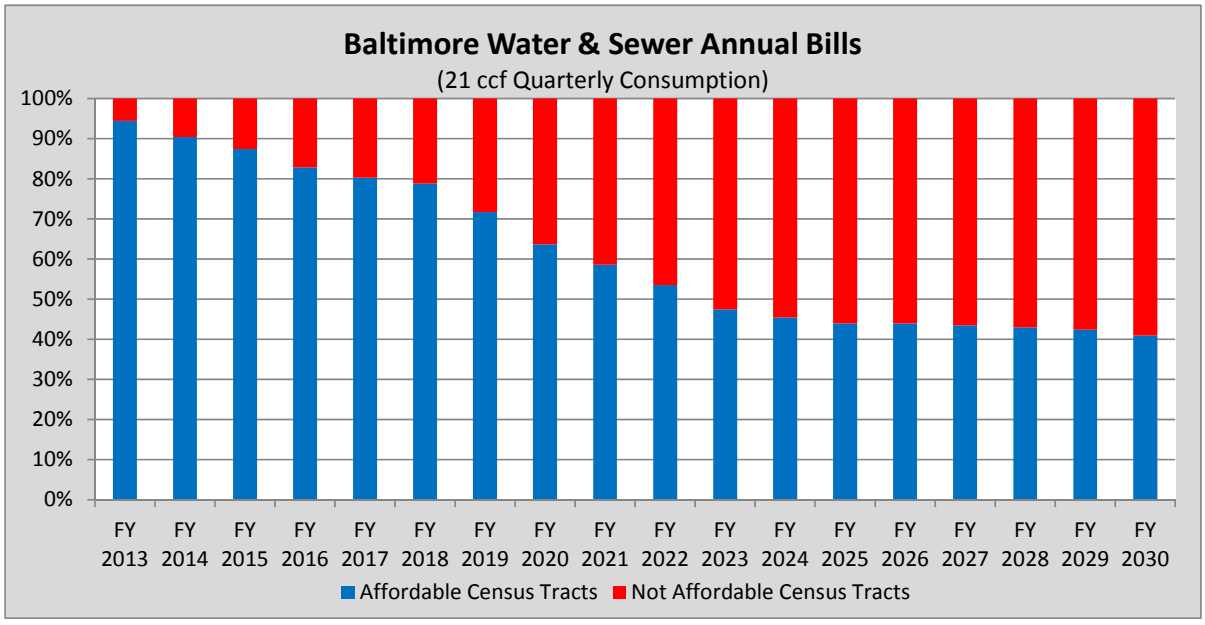

Figure 1.14. Regulatory Scenario Water and Sewer Affordability at 21 ccf/quarter

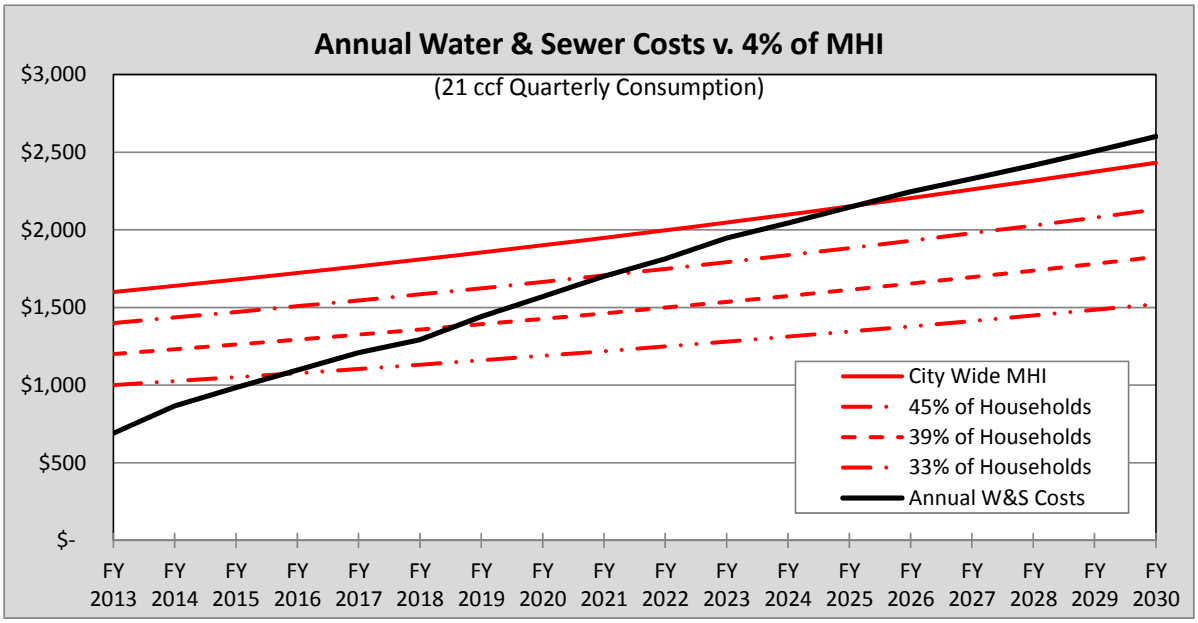

Figure 1.15. Regulatory Scenario Costs Compared to 4% of MHI for Population Percentages

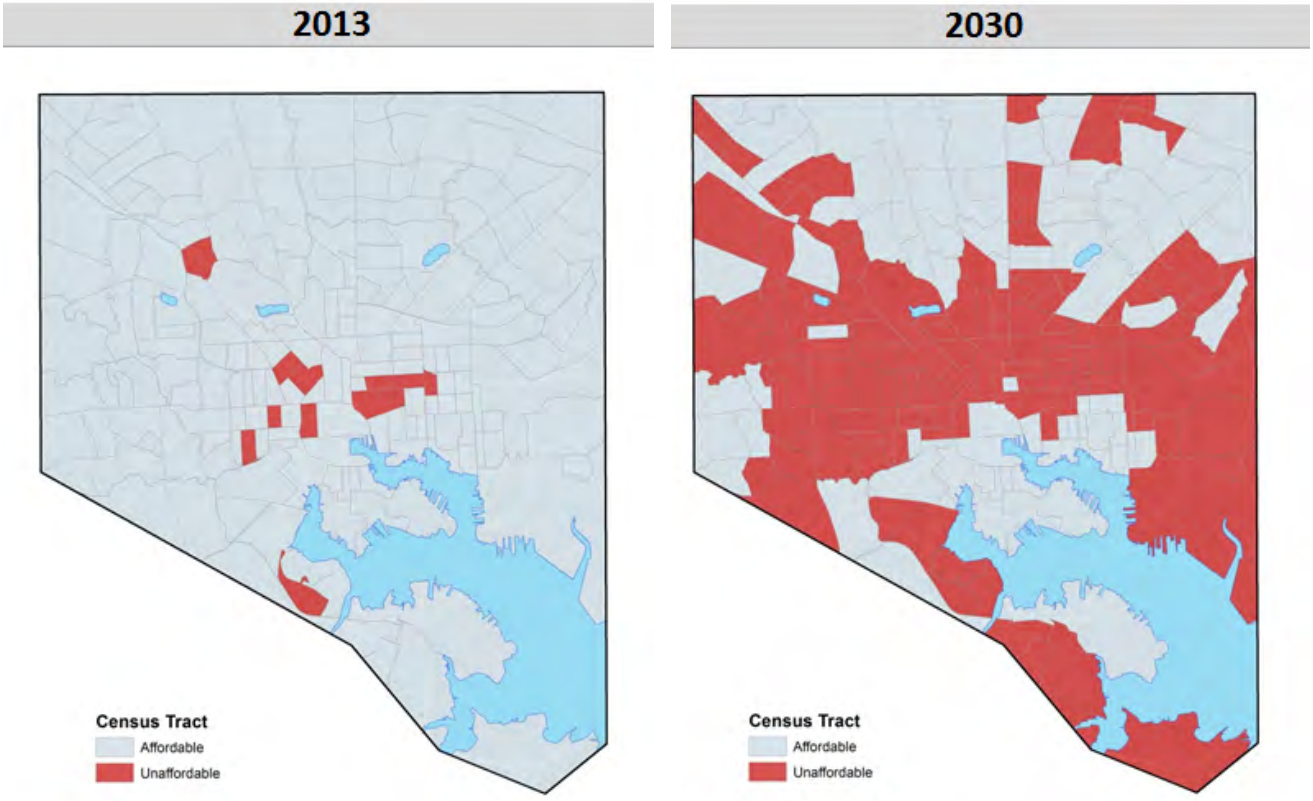

Figure 1.16. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption – Regulatory Scenario

1.6.2 Scenario 1B Results and Customer Impacts

Scenario 1B assumes a "financial cap" of approximately $250 million of annual capital investment (in present value dollars) with an average annual spend rate of $228 million. This annual investment reflects only the City's expenditure and does not include other sources such as Baltimore County's percentage share of City infrastructure funding. Scheduling of the capital projects was adjusted from the Regulatory Scenario to account for the reduced spending amounts. Reducing expenditures to allow rates to become more affordable to a greater percentage of customers results in some capital projects being delayed beyond the planning period; however, all Consent Decree related projects are completed in FY32.

The projected cumulative impact of annual rate increases on the water and wastewater rates between FY13 and FY30 are greater than a 162 percent and 119 percent, respectively.

Compared to the Regulatory Scenario, Scenario 1B leaves unfunded 18 of the lowest priority capital projects (based on the IPF results). The annual rate increases, while less than those imposed under the Regulatory Scenario, still have significant impacts on the City's customers. Therefore, the same affordability analysis needs to be applied to Alternative 1B as was performed on the Regulatory Scenario.

Projected customer rates and detailed customer impact information based on the Scenario 1B is included in Appendix F. The customer impacts from Scenario 1B result in the following outcomes:

- Customer's annual water and sewer costs will increase by approximately 250 percent by FY30.
- Assuming 39 ccf (Baltimore design-based standard for family of four) of quarterly water consumption:
    - Annual water and sewer costs become unaffordable in FY16 (4.2 percent) and represent 7.0 percent of City-wide MHI in FY30.
    - Annual water and sewer costs are unaffordable in FY13 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 9.4 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs are unaffordable for 43 percent of the City's census tracts in FY14 (representing approximately 39 percent of the City's population). By FY29, water and sewer costs would be classified as unaffordable for 90 percent of the City's census tracts (87.5 percent of the City's population).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs are already unaffordable. Customers spend approximately 6.8 percent of their income on water and sewer in FY13; this increases to approximately 15.7 percent of their annual income on water and sewer by FY30.
        - This group includes 25 percent of families with children under five years old.
    - 45 percent of all households (including 37 percent of families) will be spending 4.1 percent of annual income on water and sewer costs in FY14.

- Assuming 21 ccf (residential average) of quarterly water consumption:
    - Annual water and sewer costs represent 3.9 percent of City-wide MHI by FY30.
    - Annual water and sewer costs become unaffordable in FY21 (4.0 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 5.3 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs become unaffordable for 28 percent of the City's census tracts by FY22 (representing approximately 22.7 percent of the City's population including 24.6 percent of families).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs represent 4.7 percent of income in FY14. Customers will spend approximately 8.8 percent of their annual income on water and sewer by FY30.
    - The annual water and sewer costs are already unaffordable for the 77,000 people currently living below 50 percent of the federal poverty line, and account for over 7.7 percent of their income.
    - 33% of all households (including 25 percent of families) will be spending 4.0% of annual income on water and sewer costs in FY17.
- These results are summarized in Figure 1.17, Figure 1.18, Figure 1.19, Figure 1.20, Figure 1.21, and Figure 1.22. Figure 1.19 and Figure 1.22 are maps depicting the City's census tracts and their unique affordability status at the end of the forecast period. A red census tract district is unaffordable based on its individual MHI.

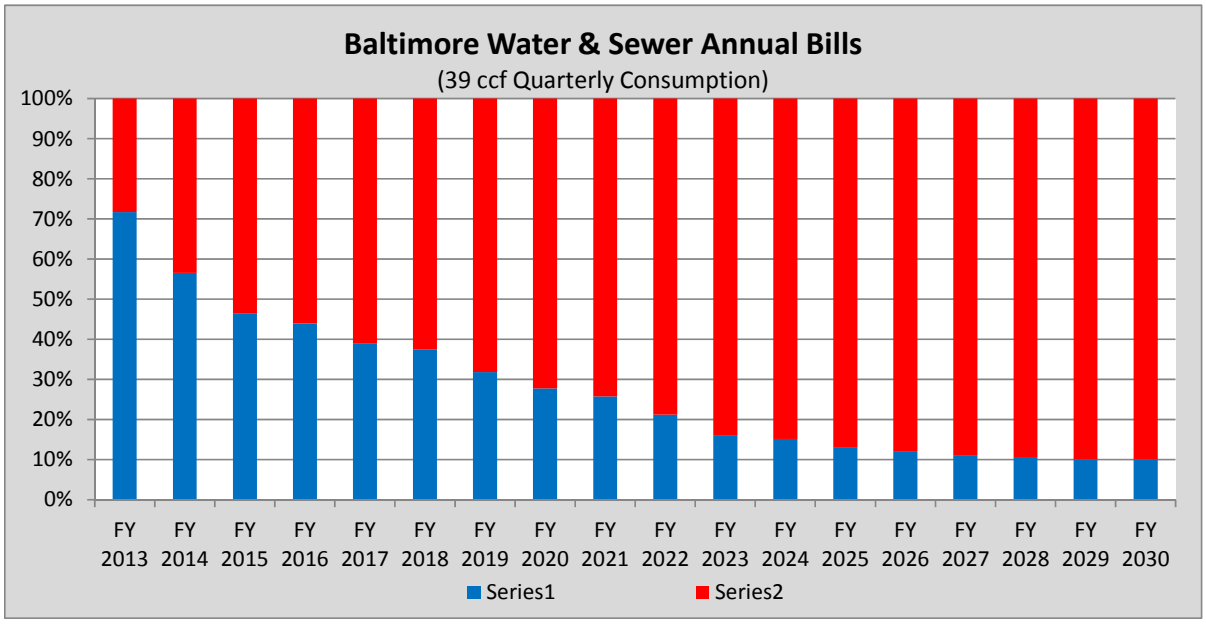

Figure 1.17. Scenario 1B Water and Sewer Affordability at 39 ccf/quarter

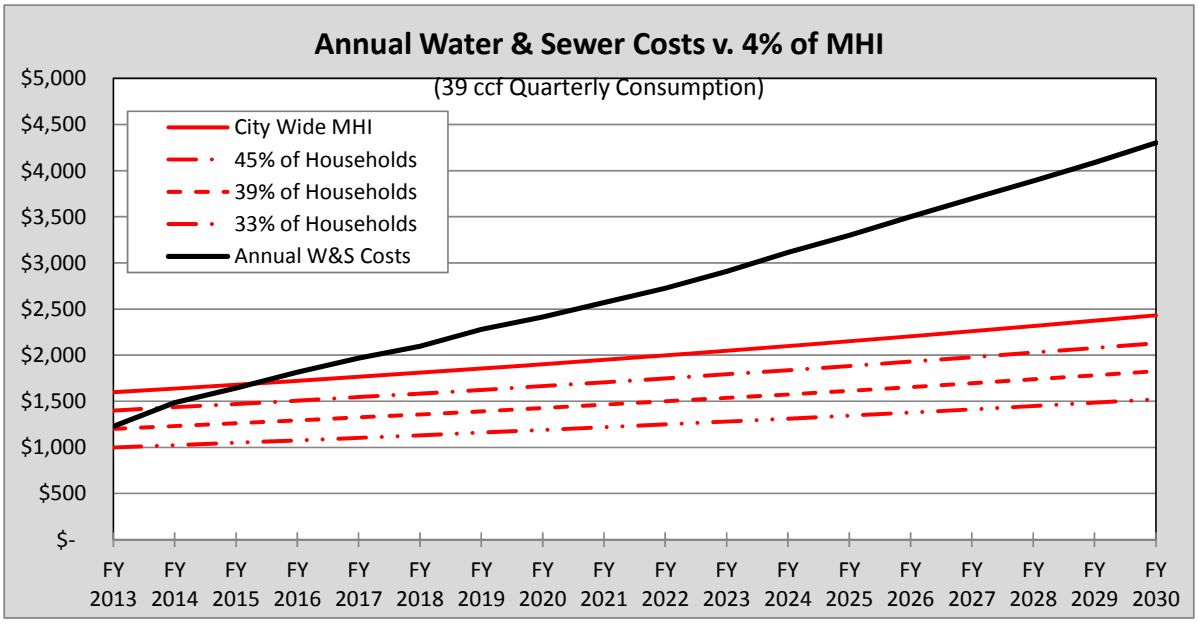

Figure 1.18. Scenario 1B Costs Compared to 4% of MHI for Population Percentages

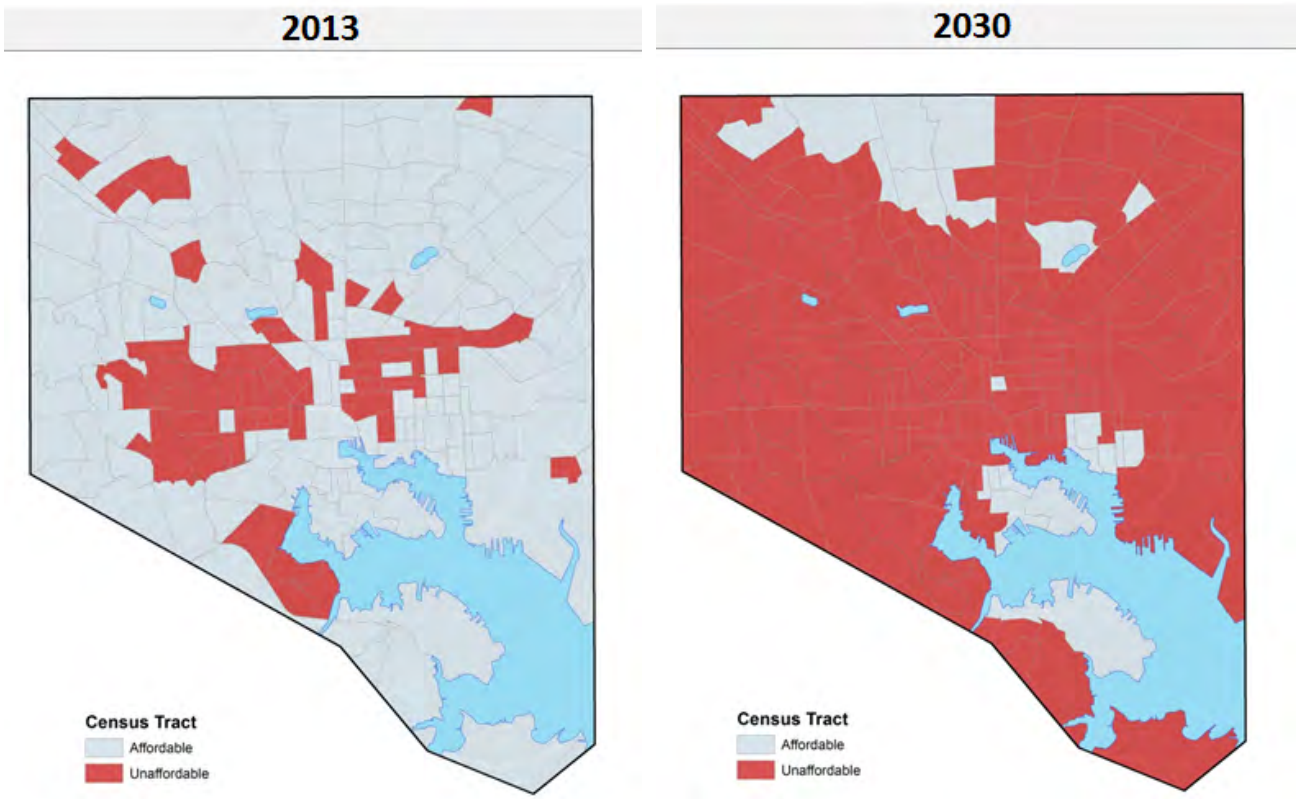

Figure 1.19. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Scenario 1B

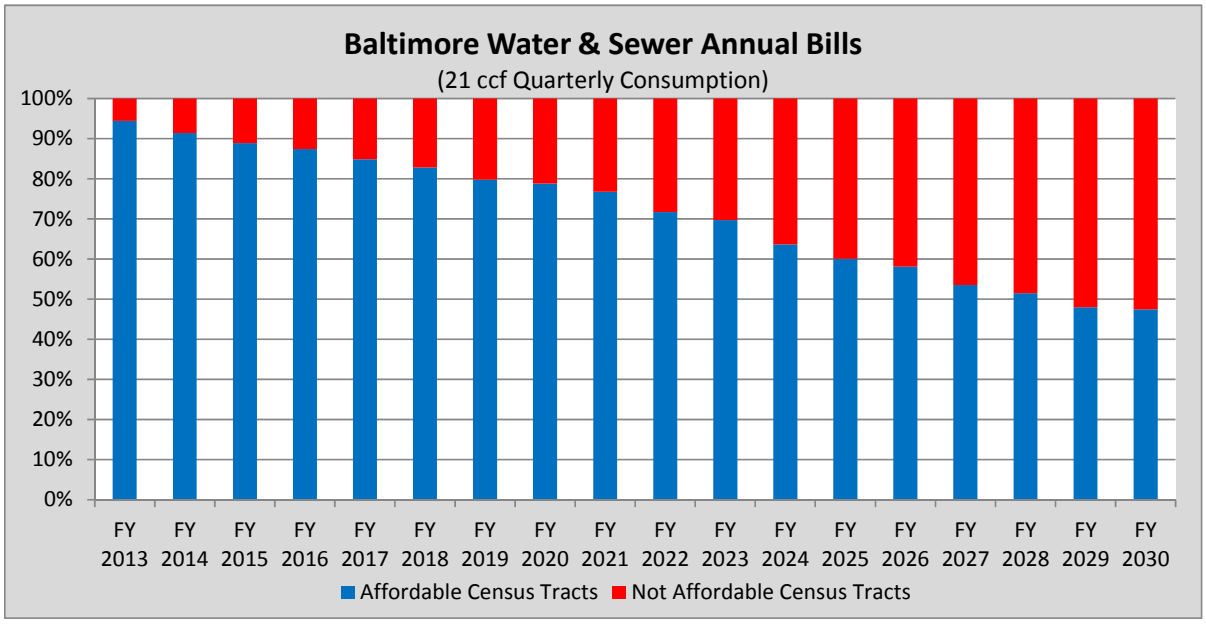

Figure 1.20. Scenario 1B Water and Sewer Affordability at 21 ccf/quarter

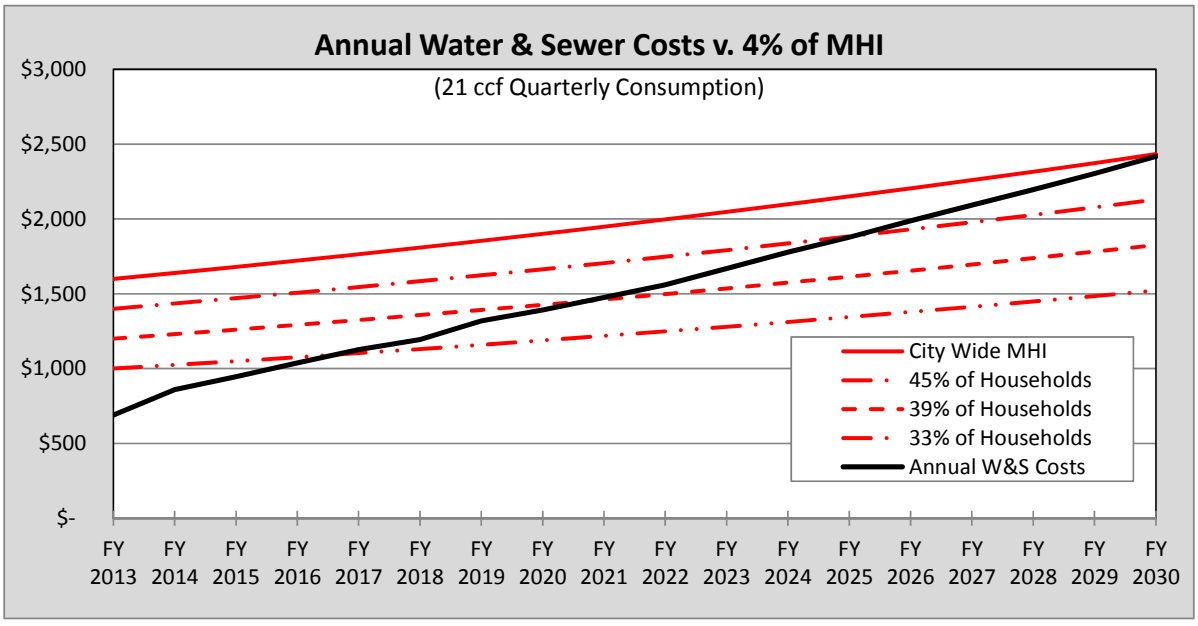

Figure 1.21. Scenario 1B Costs Compared to 4% of MHI for Population Percentages

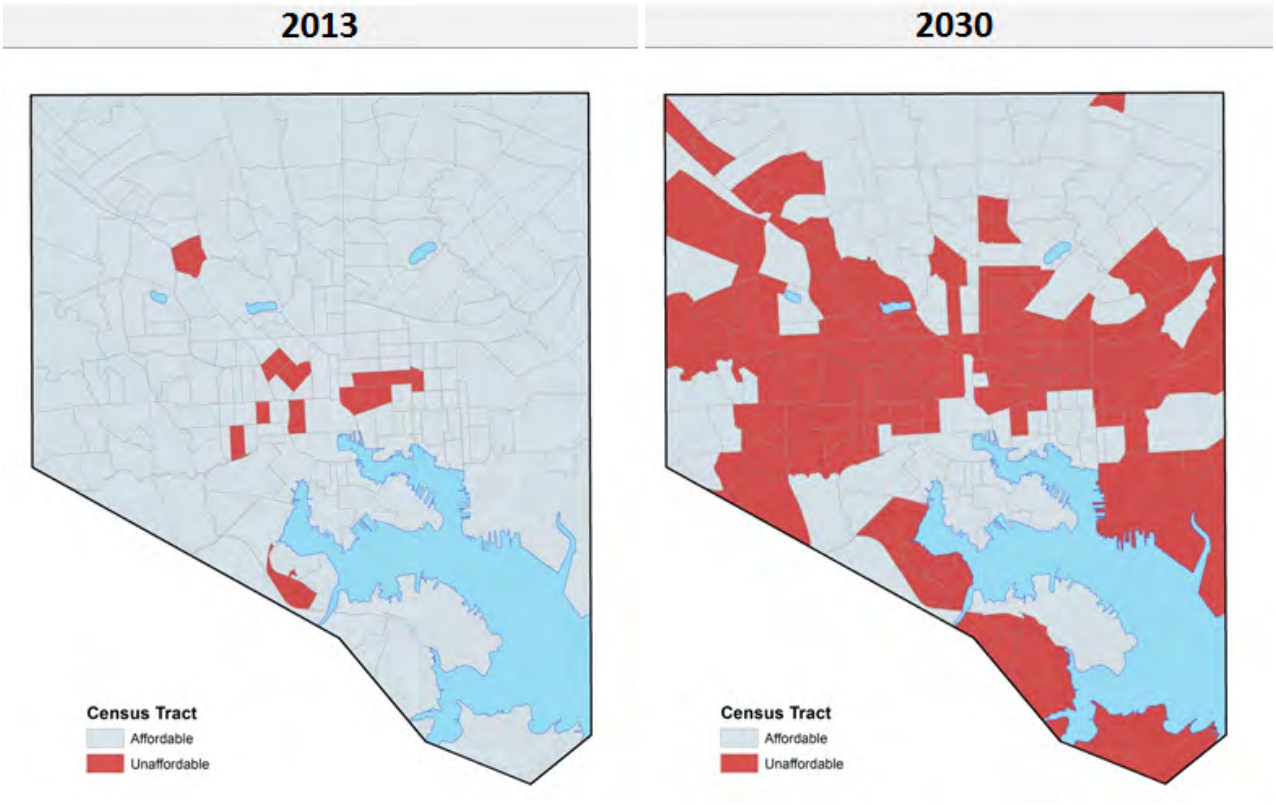

Figure 1.22. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption –Scenario 1B

1.7 Financial Analysis Impacts on Project Scheduling

Based on the financial analyses, the proposed year-by-year plan to complete each of the prioritized projects in the IPF Project List is shown below.

Based on the IPF Project List scores, importance weighting factors, and financial analyses, anticipated spending schedules for each scenario were generated. Figure 1.10. Cumulative Baltimore City Income Distribution and Figure 1.23. Project Annual Spending – Scenario 3, Regulatory (Status Quo) present the anticipated spending schedules for each of the two primary scenarios evaluated in this IPF report (the Regulatory Scenario and Scenario 1B).

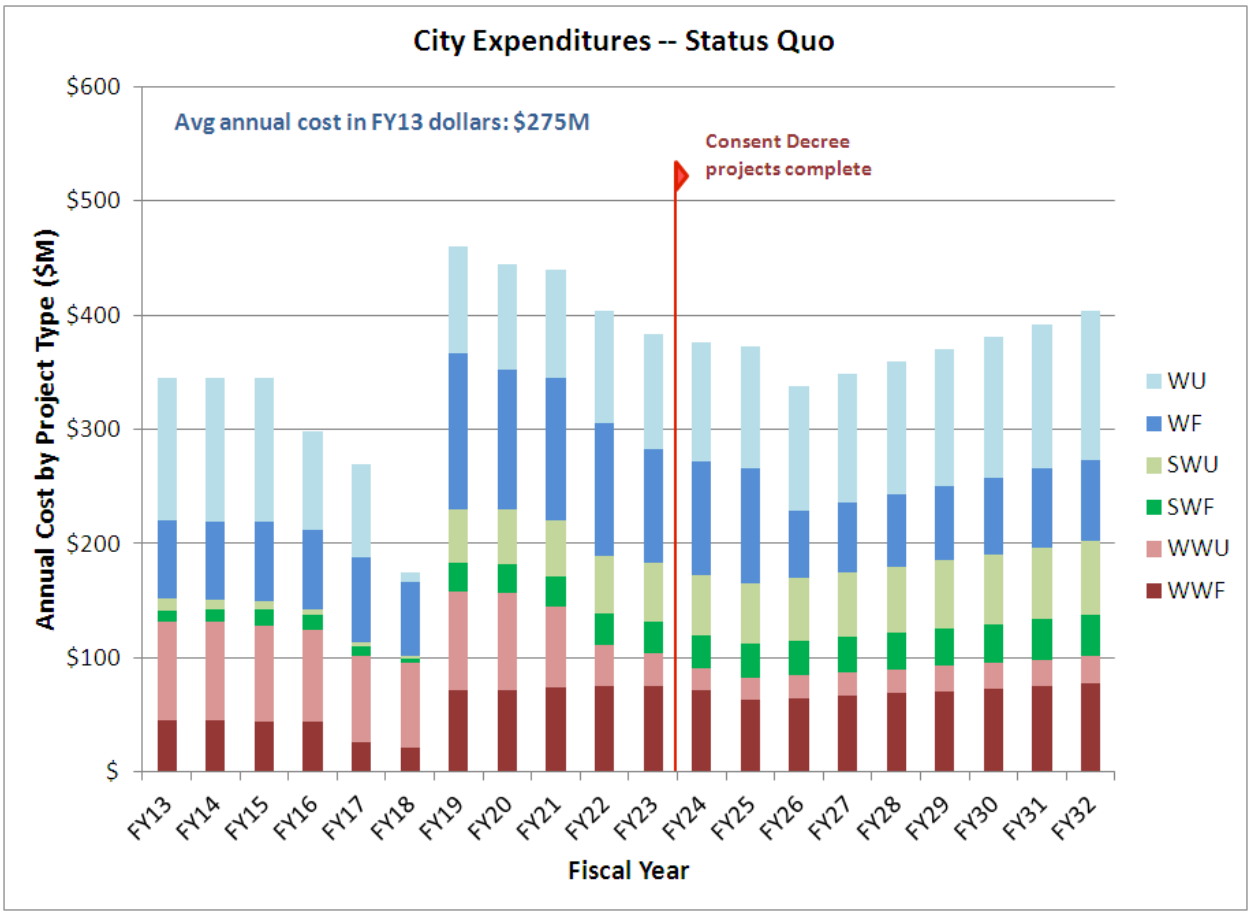

Figure 1.23. Project Annual Spending – Scenario 3, Regulatory (Status Quo)

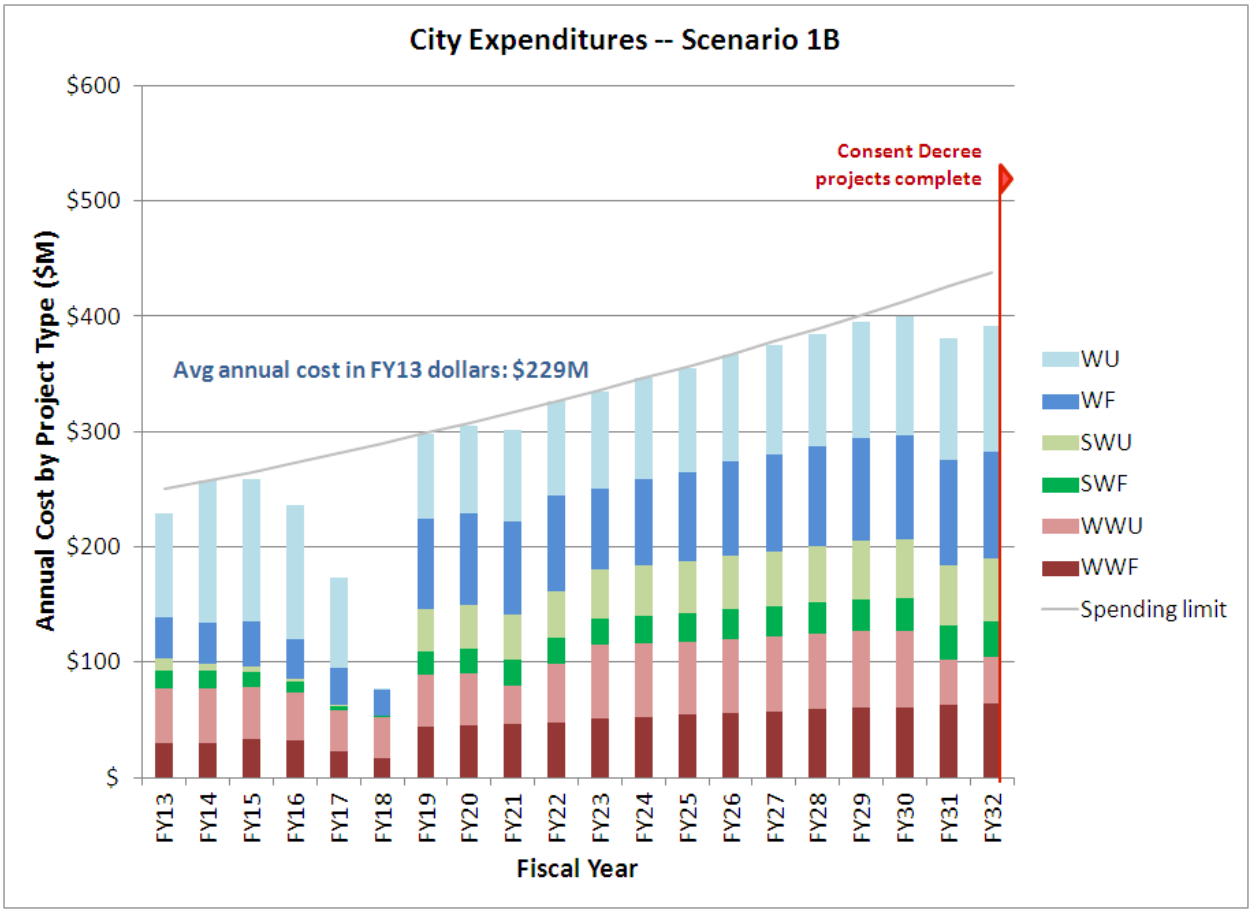

Figure 1.24. Project Annual Spending – Scenario 1B

The project scheduling model results demonstrates that the City will complete the regulatory-driven prioritized projects in the IPF project list by 2032. The Consent Decree, as currently written, requires that the sewershed plan schedules are to be completed January 1, 2016, although an extension is being considered by EPA and MDE. The results of the City's IPF demonstrate that a Consent Decree extension will be necessary in order to provide sustainable water, wastewater and stormwater services to the citizens of Baltimore. Figure 1.25 presents the Scenario 1B anticipated project schedule.

Figure 1.25. Anticipated IPF Project Schedule – Scenario 1B

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
SWF	525-405	ER4023 Biddison Run Environmental Restoration Project 2 (3030 ft length upstream of Moravia to Sipple Ave, 3,850 ft length - Sipple Ave to Sinclare Lane)	0.67	$3.08																				
SWF	525-NEW	Stream Restoration TBD	0.64	$5.30																				
SWF	525-NEW	Moores Run Environmental Restoration Projects	0.60	$5.19																				
SWF	525-NEW	Chinquapin Run Environmental Restoration Projects	0.60	$3.45																				
SWF	525-NEW	Stony Run Environmental Restoration Projects	0.54	$4.00																				
SWF	525-405	ER4018 Powder Mill Run	0.53	$1.50																				
SWF	NEW	Representative Recurrent Project: Outfalls	0.50	$796.62																				
SWF	525-NEW	ER4031 Franklin Town Blvd Culvert Stream Restoration (2400 ft including 452 ft tributary)	0.50	$1.22																				
SWF	525-405	ER4028 Western Run Environmental Restoration Project 2 (Kelly Ave - 1000 ft)	0.45	$1.22																				
SWF	525-NEW	Urban Watershed Retrofit Projects Back River WS	0.45	$1.68																				
SWF	525-NEW	Urban Watershed Retrofit Projects Direct Harbor WS	0.44	$6.72																				
SWF	525-NEW	Urban Watershed Retrofit Projects Gwynns Falls WS	0.44	$3.36																				
SWF	525-NEW	Urban Watershed Retrofit Projects Jones Falls WS	0.44	$3.36																				
SWF	525-NEW	Facility Greening Projects Gwynns Falls WS	0.44	$1.29																				
SWF	525-NEW	Facility Greening Projects Jones Falls WS	0.44	$1.72																				
SWF	525-NEW	Facility Greening Projects Back River WS	0.44	$1.72																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Gwynns Falls WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Back River WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Jones Falls WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Direct Harbor WS (600 inlets)	0.44	$0.88																				
SWF	525-NEW	Facility Greening Projects Direct Harbor WS	0.44	$3.44																				
SWF	525-NEW	In-line Debris Collection System Projects Gwynns Falls	0.38	$1.74																				
SWF	525-NEW	In-line Debris Collection System Projects Direct Harbor WS	0.37	$2.32																				
SWF	525-NEW	In-line Debris Collection System Projects Jones Falls	0.37	$1.16																				
SWF	525-449	ER4016 Bush Street Debris Collector	0.36	$3.05																				
SWF	525-NEW	ER4034 Biddison Run Debris Collector Project 1	0.35	$0.70																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
SWU	520-NEW	Patapsco Avenue Drainage Improvement	0.44	$4.52																				
SWU	NEW	Representative Recurring Project: Conveyance	0.44	$1420.06																				
SWU	520-NEW	North Point Road Drainage Improvement	0.44	$4.48																				
SWU	520-NEW	2300 Block Seamon Ave	0.44	$0.30																				
SWU	520-400	Pulaski Highway Drain and Inlet Rehabilitation	0.44	$0.43																				
SWU	520-093	Race Street Box Culvert	0.39	$3.50																				
SWU	520-708	Storm Water Pumping Station Improvements Highland Town	0.38	$1.63																				
SWU	520-715	Northeast Baltimore Drainage Improvements	0.38	$3.20																				
SWU	NEW	Harris Creek Storm Drainage	0.37	$6.59																				
SWU	520-451	Fairmount Storm Drain Improvements	0.35	$1.85																				
SWU	520-NEW	Public Storm Drain System Hydraulic Modeling and Asset Management	0.28	$4.00																				
WF	557-928	Urgent needs - Water Facilities Engineering	0.55	$0.75																				
WF	NEW	Representative Recurring Project: Reservoirs & Tanks	0.52	$173.18																				
WF	NEW	Preventive Maintenance Program	0.50	$3.00																				
WF	557-573	Raw water Tunnel Inspections	0.50	$0.50																				
WF	557-709	Finished Water Improvements - Montebello 2 FW Reservoir	0.47	$8.69																				
WF	557-713	Finished Water Improvements - Towson FW Reservoir	0.47	$3.47																				
WF	NEW	Representative Recurring Project: Montebello Preliminary/Settling Upgrade $35M	0.47	$126.75																				
WF	NEW	Representative Recurring Project: Ashburton Preliminary/Settling Upgrade $25M	0.45	$156.15																				
WF	557-300	Representative Recurring Project: Montebello Generator $15M	0.45	$48.96																				
WF	NEW	Representative Recurring Project: Montebello Chemical Systems Upgrade $35M	0.43	$123.94																				
WF	NEW	Representative Recurring Project: Montebello 1 Membrane Filteration $60M	0.43	$331.02																				
WF	NEW	Representative Recurring Project: Ashburton Generator $10M	0.43	$57.67																				
WF	557-730	Fullerton Water Filtration Plant WC 1169	0.43	$182.25																				
WF	557-068	Pretty Boy Reservoir - Roads & Culvert repair	0.42	$6.74																				
WF	557-068	Liberty Reservoir - Roads & Culvert repair	0.42	$3.32																				
WF	557-501	Montebello Water Filtration Plant Laboratory Facilities	0.41	$6.81																				
WF	557-927	Ashburton Chemical Laboratory	0.41	$2.38																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WF	557-068	Loch Raven - Roads & Culvert repair	0.41	$3.96																				
WF	557-924	Pikesville Pump Station Rehabilitation	0.40	$0.00																				
WF	557-926	Towson Pump Station Rehabilitation	0.40	$0.10																				
WF	557-922	Vernon Pump Station Rehabilitation	0.40	$11.13																				
WF	557-923	Cromwell Pump Station Rehabilitation	0.40	$7.12																				
WF	NEW	Representative Recurring Project: Inspection/Maintenance of PS'S	0.39	$742.45																				
WF	NEW	Water Recycling and Solids Handling - Ashburton	0.39	$12.83																				
WF	NEW	Staffing Needs	0.39	$0.50																				
WF	557-715	UV disinfection - Ashburton FW Reservoir	0.38	$31.31																				
WF	NEW	Representative Recurring Project: Pumping Stations	0.37	$346.36																				
WF	557-920	Maint Bldg. Impr. At Loch Raven Dam	0.36	$7.08																				
WF	557-158	Earthen Dam Improvement Program WC-1127	0.35	$3.69																				
WF	557-709	Finished Water Improvements - Guilford FW Reservoir	0.31	$19.96																				
WF	557-727	Deer Creek Pumping Station Improvements	0.30	$6.54																				
WF	557-917	Guilford Pumping Station Rehabilitation WC 1120	0.29	$9.46																				
WF	NEW	Personnel training in Electrical and Instrumentation certification.	0.26	$0.30																				
WF	NEW	Montebello Washwater Lake Dredging & Remediation	0.24	$13.90																				
WF	NEW	Representative Recurring Project: Ashburton Recycle Facilities $30M	0.04	$185.61																				
WU	557-101	Water Mains - Installation	0.62	$10.11																				
WU	557-687	Large Main Rehab & Replacement, PCCP	0.61	$0.15																				
WU	NEW	Water Main Rehabilitation and Replacement in Identified Areas	0.61	$22.91																				
WU	NEW	Large Main Rehab & Replacement, cast iron and steel	0.60	$21.28																				
WU	557-100	Water Infrastructure Rehabilitation	0.57	$329.32																				
WU	557-689	Urgent Needs Water Engineering Services	0.52	$4.72																				
WU	557-031	Water Distribution System - Improvements	0.47	$13.49																				
WU	NEW	Leak Detection & Rehab – Large mains	0.44	$1.50																				
WU	NEW	Large Valve Replacement	0.36	$2.94																				
WU	557-002	Water Utility Billing System	0.36	$12.50																				
WU	557-133	Meter Replacement Program	0.34	$98.93																				
WU	557-400	Valve and Hydrant Exercising - Annual	0.33	$0.74																				
WU	557-638	Water Audit	0.33	$9.55																				
WU	NEW	SCADA Upgrades	0.32	$7.10																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WU	557-130	Water System Cathodic Protection	0.30	$4.96																				
WU	NEW	Representative Recurring Project: Pipelines/Distribution System	0.00	$2859.35																				
WWF	551-528	Patapsco ENR Denitrification and Nitrification	0.41	$11.67																				
WWF	551-689	Back River WWTP Primary and Influent Facilities Rehabilitation SC-918	0.39	$56.20	CD	CD	CD	CD	CD	CD														
WWF	551-687	Patapsco Chlorine Conversion SC-857	0.28	$1.36																				
WWF	551-752	McComas Street PS/FM Upgrade	0.26	$1.63																				
WWF	551-755	Pump Station Force Main Improvements, various locations	0.25	$9.64																				
WWF	551-533	SCADA System Upgrades, Var. Pumping Stations	0.25	$0.40																				
WWF	551-585	Pat LOX Plant Upgrade SC-868	0.23	$1.36																				
WWF	551-561	Back River Settling Tanks	0.23	$2.19																				
WWF	551-526	Back River Digester Renovation SC-8526	0.19	$24.68																				
WWF	551-692	Patapsco Electrical System Upgrade	0.19	$21.86																				
WWF	551-692	Back River Electrical System Upgrade	0.18	$18.43																				
WWF	551-533	Back River Facilities Improvements	0.17	$3.38																				
WWF	551-685	Back River Scum & Grease System	0.16	$2.77																				
WWF	551-533	Annual Facilities Improvements	0.16	$4.50																				
WWF	NEW	Optimization of Inventory Control	0.16	$2.33																				
WWF	551-681	WW Facilities Security Improvements	0.16	$1.00																				
WWF	NEW	Redundancy Systems for Pump Stations/Force Mains	0.14	$3.26																				
WWF	551-533	Patapsco Facilities Improvements	0.13	$7.62																				
WWF	NEW	Expansion of Co-Gen Facility (4th Boiler Given Price Natural Gas)	0.11	$1.23																				
WWF	NEW	Representative Recurring Project: Patapsco Green Energy $15M	0.06	$27.27																				
WWF	NEW	Representative Recurring Project: Patapsco Chemical Facilities Upgrade $10M	0.06	$19.57																				
WWF	NEW	Representative Recurring Project: Back River Green Energy $15M	0.06	$42.61																				
WWF	NEW	Representative Recurring Project: Patapsco Hypochlorite Generation Facility $25M	0.05	$44.40																				
WWF	NEW	Representative Recurring Project: Back River Sludge Storage Facility $25M	0.05	$71.01																				
WWF	NEW	Representative Recurring Project: Back River Hypochlorite Generation Facility $30M	0.05	$83.16																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WWF	NEW	Representative Recurring Project: Patapsco Pelletization Facility Upgrade $40M	0.04	$71.95																				
WWF	NEW	Representative Recurring Project: Patapsco Secondary Treatment Upgrades $50M	0.04	$97.03																				
WWF	NEW	Representative Recurring Project: Patapsco Sludge Digestion Facilities $50M	0.04	$80.22																				
WWF	NEW	Representative Recurring Project: Back River Pelletization Faciltiy Upgrade $60M	0.03	$170.09																				
WWF	NEW	Representative Recurring Project: Back River Egg-Shaped Digester Additions $75M	0.03	$234.26																				
WWF	NEW	Representative Recurring Project: Back River Secondary Treatment Upgrades $75M	0.03	$234.26																				
WWF	NEW	Representative Recurring Project: Pumping Stations & Force Mains	0.02	$519.54																				
WWU	551-627	Wet Weather Program Operation and Management	0.71	$8.70	CD	CD	CD	CD																
WWU	551-410	Herring Run Interceptor improvements	0.59	$3.81																				
WWU	551-611	Low Level Sewershed Improvements	0.58	$83.21	CD	CD	CD	CD	CD	CD	CD	CD	CD											
WWU	551-616	Patapsco Sewershed Improvements	0.56	$20.78	CD	CD	CD	CD	CD	CD	CD	CD												
WWU	551-622	Gwynns FallsSewershed Improvements	0.56	$77.07	CD	CD	CD	CD	CD	CD	CD	CD												
WWU	NEW	Sanitary Sewer Interceptors, Siphon And Right of Way Cleaning	0.54	$27.50																				
WWU	551-612	Outfall Sewershed Improvements	0.53	$109.07	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD									
WWU	551-626	Jones Falls Sewershed Improvements	0.50	$114.23											CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
WWU	551-624	Herring Run Sewershed Improvements	0.47	$235.35										CD	CD	CD	CD	CD	CD	CD	CD	CD		
WWU	551-609	SW Diversion Pressure Sewer Improvements	0.45	$13.48																				
WWU	551-620	High LevelSewershed Improvements	0.44	$82.82												CD	CD	CD	CD	CD	CD	CD	CD	CD
WWU	551-404	Improvements/Rehab of Existing Sanitary Sewer	0.43	$3.88																				
WWU	551-614	Dundalk Sewershed Improvements	0.42	$9.58											CD	CD	CD	CD	CD	CD	CD	CD		
WWU	551-144	GIS Updates & Mapping Program	0.41	$6.28																				
WWU	NEW	Representative Recurring Project: Collection System	0.40	$517.08																				

1.8 Performance Monitoring and Improvement Plans

The IPF process presented in this report will be implemented in phases. The initial IPF phases are described in this report. The next phase will extend the process to key stakeholders, with EPA and MDE being the first agencies brought into the plan development. Based on EPA's and MDE's input, the City will reach out to targeted environmental and community groups before finalizing the proposed IPF process.

Once the final proposed IPF process is completed, the plan will be formally submitted to State and federal regulatory agencies. The existing 2002 Consent Decree will need to be modified to fully implement the IPF process. The Consent Decree modification process will likely be time-consuming and may require further adjustments to the IPF process. It is also possible that future NPDES permits will need to reflect the decisions being made as part of the IPF process, particularly related to implementation schedules.

Based on the results of stakeholder input, the revised Consent Decree, future permit implementation schedules and the City's monitoring program outlined in Section 9, Measures for Success, the City will implement a continuous improvement plan for the IPF. This continuous improvement plan will be based on an adaptive management approach. Fundamentally, adaptive management defines a process by which new information and changing conditions are incorporated into management efforts. The iterative nature of adaptive management aligns well with EPA guidelines for the Integrated Planning Framework that encourages use of innovative solutions and provides for a structure for continual evaluation.

Adaptive management will be refined as the implementation process continues, but is expected to include the following components.

- Providing opportunities for meaningful public input on at least an annual basis;
- Reviewing the City's IPF Project List annually for needed adjustments based on changed conditions or schedule needs, such as the newly confirmed FY14 to FY19 CIP data;
- Reviewing input from the UAMD on recurrent capital and O&M programs and their associated costs;
- Reviewing the benefits criteria scoring for projects on the City's IPF Project List on a periodic basis, but not less than every two years;
- Reviewing the scoring plans for each benefit criterion to incorporate modifications required by completed performance monitoring results on a periodic basis, but not less than every two years;
- Reviewing the importance weightings for the benefit criteria based on City and stakeholder input as needed, but not less than once every four years;
- Developing an updated IPF Project List and Schedule on a periodic basis, but not less than every two years;
- Compiling documentation and justification to support modifications to the IPF Project List and Schedule, if additional Consent Decree or permit modifications are required; and
- Submitting IPF modification request and supporting justifications to regulatory agencies and negotiate modified Consent Decree terms or permit modification, if needed.

2 INTEGRATED PLANNING FRAMEWORK PURPOSE

2.1 EPA Guidance

The U.S. Environmental Protection Agency ("EPA") has committed to work with states and communities to implement and utilize integrated planning approaches to municipal wastewater and stormwater management.[8] This new approach is designed to assist municipalities to achieve the human health and water quality objectives under the Clean Water Act ("CWA") by identifying efficiencies in implementing the sometimes overlapping and competing requirements that arise from distinct wastewater and stormwater programs.

EPA issued guidance for communities voluntarily implementing this new integrated planning approach. The EPA's guiding principles[9] for the Integrated Planning Framework ("IPF") are presented below.

Overarching Principles

The EPA guidance document defines the following overarching principles that EPA will use in working with municipalities to implement an integrated approach.

1. This effort will maintain existing regulatory standards that protect public health and water quality.
2. This effort will allow a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first.
3. The responsibility to develop an integrated plan rests with the municipality that chooses to pursue this approach. Where a municipality has developed an initial plan, EPA and/or the State will determine appropriate actions, which may include developing requirements and schedules in enforceable documents.
4. Innovative technologies, including green infrastructure, are important tools that can generate many benefits, and may be fundamental aspects of municipalities' plans for integrated solutions.

Principles to Guide the Development of an Integrated Plan

The EPA guidance further notes that integrated plans should:

1. Reflect State requirements and planning efforts and incorporate State input on priority setting and other key implementation issues.
2. Provide for meeting water quality standards and other CWA obligations by utilizing existing flexibilities in the CWA and its implementing regulations, policies and guidance.
3. Maximize the effectiveness of funds through analysis of alternatives and the selection and sequencing of actions needed to address human health and water quality related challenges and non-compliance.

[8] U. S. Environmental Protection Agency, *Achieving Water Quality Through Municipal Stormwater and Wastewater Plans,* October 27, 2011. Available at http://cfpub.epa.gov/npdes/integratedplans.cfm.

[9] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework,* May 2012 (issued June 5, 2012).

4. Evaluate and incorporate, where appropriate, effective sustainable technologies, approaches and practices (including green infrastructure measures) in integrated plans where they provide more sustainable solutions for municipal wet weather control.
5. Evaluate and address community impacts and consider disproportionate burdens resulting from current approaches as well as proposed options.
6. Ensure that existing requirements to comply with technology-based and core requirements are not delayed.
7. Ensure that a financial strategy is in place, including appropriate fee structures.
8. Provide appropriate opportunity for meaningful stakeholder input throughout the development of the plan.

2.2 City of Baltimore Goals

Along with many other municipalities throughout the United States, the City of Baltimore (the "City" or "Baltimore City") has committed unprecedented funds to comply with the CWA and the Safe Drinking Water Act ("SDWA") at the expense of infrastructure renewal and other local environmental priorities. Recent national economic downturns and associated funding constraints have only served to compound the financial stress within the City's water and wastewater system.

The City intends to use EPA's more flexible approach as envisioned in the integrated planning approach to:

- Meet water quality standards;
- Protect community health;
- Maintain a fiscally responsible rate structure for our customers; and
- Revitalize the local economy by promoting a more sustainable urban community.

As demonstrated in this IPF report, the City will integrate the wastewater and stormwater obligations under the CWA, as well as demonstrate the applicability of including water obligations under the SDWA. The City's IPF includes analysis of three scenarios with varying levels of regulatory constraint assumptions to obtain a prioritized list of Capital Improvement Program ("CIP") projects and recurrent capital and O&M expenditures that achieve greater public health and environmental benefits earlier than mandates may provide.

2.3 Report Objectives and Organization

EPA has established six minimum plan elements for an acceptable integrated plan. These elements, and the location(s) within this report structure where each element is addressed, are summarized below:

- ***Element 1.*** A description of the water quality, human health and regulatory issues to be addressed in the plan. This is in Section 4, Utility Challenges, of this IPF report.
- ***Element 2.*** A description of existing wastewater and stormwater systems under consideration and summary information describing the systems' current performance. This is in Section 3, Existing Infrastructure System Performance, of this IPF.

- ***Element 3.*** A process which opens and maintains channels of communications with relevant community stakeholders in the planning process and during implementation of the plan. The City's proposed stakeholder plan is presented in Section 8, Stakeholder Involvement Plans.
- ***Element 4.*** A process for identifying, evaluating and selecting alternatives and proposing implementation schedules. Section 5, IPF Model Development, presents the framework for the City's IPF process. Section 6, Scenario Development, outlines the IPF project evaluation process and presents the results of the benefit analysis for the various scenarios being evaluated. Section 7, Financial Analysis, details the financial analyses and schedule impacts associated with the various scenarios being evaluated.
- ***Element 5.*** Proposed performance criteria and measures of success including a monitoring program for evaluating the performance of projects identified in a plan, which may include evaluation of monitoring data, information developed by pilot studies and other studies and other relevant information. The City's proposed measures for success are summarized in Section 9, Measuring Success.
- ***Element 6.*** A process for identifying, evaluating and selecting proposed new projects or modifications to ongoing projects and implementation schedules based on changing circumstances. The City's IPF implementation plan is presented in Section 10, Improvements to the Plan.

3 EXISTING INFRASTRUCTURE SYSTEM PERFORMANCE

3.1 Infrastructure Overview

The Bureau of Water and Wastewater (the "Bureau") is responsible for the City's water, wastewater and surface water (i.e., stormwater) infrastructure. The Bureau supplies drinking water to 1.8 million people in the Baltimore Metropolitan Area, collects and treats over 200 million gallons per day ("mgd") of wastewater generated regionally; maintains the City's storm drain system; and operates three Reservoir Watersheds, three Water Filtration Plants ("WFPs") and two Wastewater Treatment Plants ("WWTPs"). The Bureau's organizational structure for managing this infrastructure is summarized in Table 3.1 along with an identification of the key infrastructure facilities managed by each of the six sections.

Table 3.1. Baltimore City Bureau of Water and Wastewater Sections

Bureau Section	IPF Report Abbreviation	Infrastructure Components
Water Facilities	WF	Water filtration plants, pump stations, storage structures, pump stations
Water Utilities	WU	Transmission and distribution mains
Wastewater Facilities	WWF	Wastewater treatment plants, pump stations, force mains
Wastewater Utilities	WWU	Collection system sewer mains, manholes
Surface Water Facilities	SWF	Streams, environmental restoration, debris collectors, pump stations, BMPs
Surface Water Utilities	SWU	Storm sewer mains, catch basins, outfalls

The City's water, wastewater and surface water facilities are briefly described in the following three subsections. Following the infrastructure subsections, Section 3.2, Regulatory Requirements, and Section 3.3, Infrastructure System Status, summarize performance related to regulatory compliance and infrastructure status for water, wastewater and surface water assets.

3.1.1 Water Infrastructure

Raw water is supplied by three major surface water sources: the Gunpowder Falls, North Branch Patapsco River and the Susquehanna River. Three reservoir impoundments located outside the City limits collect and store the raw water.

Liberty Reservoir is located on the North Branch Patapsco River on the boundary between Baltimore and Carroll Counties. It collects water from a 163.4 square mile drainage area that includes eastern Carroll County and southwestern Baltimore County. Liberty Dam was completed in 1954 and impounds approximately 43 billion gallons of raw water with a surface area of approximately 3,900 acres. Water from Liberty Reservoir flows by gravity through a 12.7-mile long, 10-foot diameter tunnel for treatment at the Ashburton WFP.

Loch Raven Reservoir is north of Baltimore City. Its watershed occupies northern Baltimore County and small parts of western Harford County and southern York County, Pennsylvania.

The source of reservoir water is Gunpowder Falls. Loch Raven Dam was constructed in 1915 and raised to its current height in 1923. The Loch Raven Dam impounds approximately 23 billion gallons with a surface area of approximately 2,400 acres. Raw water from Loch Raven Reservoir travels through a 7.3-mile, 12-foot diameter tunnel for treatment at the Montebello I or Montebello II WFPs.

Prettyboy Reservoir is in the northwest corner of Baltimore County with an 80 square mile watershed including northern Baltimore County and small portions of northeastern Carroll County and southern York County, Pennsylvania. Prettyboy Dam was completed in 1932 and impounds about 19 billion gallons of water covering about 1,500 acres. Prettyboy Reservoir water is transferred to Loch Raven Reservoir via the Gunpowder Falls rather than directly to a filtration plant. The dam releases water as needed into the river channel, which flows into Loch Raven Reservoir.

In addition to the three City-owned reservoirs, the City also relies on raw water from the Susquehanna River, which is stored in the Conowingo Reservoir, formed by the Conowingo Hydroelectric Dam. The dam is owned and operated by the Exelon Corporation. The Conowingo Reservoir is located approximately 11 miles north of Aberdeen near the Pennsylvania State line. Susquehanna River water is pumped via Deer Creek Pumping Station to the Montebello WFPs through the 38-mile long Susquehanna Conduit. This water source is normally used during times of extreme drought when storage reaches low levels in the reservoirs. The City has an agreement with the Susquehanna River Basin Commission (“SRBC”) that allows diversion of up to 250 mgd during non-trigger events. During trigger events (defined by the flow measured at the Marietta Pennsylvania gage), the City is allowed to divert 84 mgd on a 30-day average and a peak day diversion of up to 142 mgd. During trigger events, restrictions are placed on the Deer Creek stand-by pump station.

The City operates three water filtration plants with a combined safe treatment capacity of 405 mgd.

- The Montebello I WFP was placed in service in 1915 and can treat up to 128 mgd. The plant has two rapid mix chambers, four flocculators, four sedimentation basins and 32 rapid sand filters.
- The Montebello II WFP was placed in service in 1928 and can treat up to 112 mgd. The plant has two rapid mix chambers, three flocculators, three sedimentation basins and 28 rapid sand filters.
- The Ashburton WFP was placed into service in 1956 and has a capacity of 165 mgd. The plant includes four flocculators, four sedimentation basins and 20 rapid sand filters.

The treatment plant process employed at the plants is illustrated in Figure 3.1.

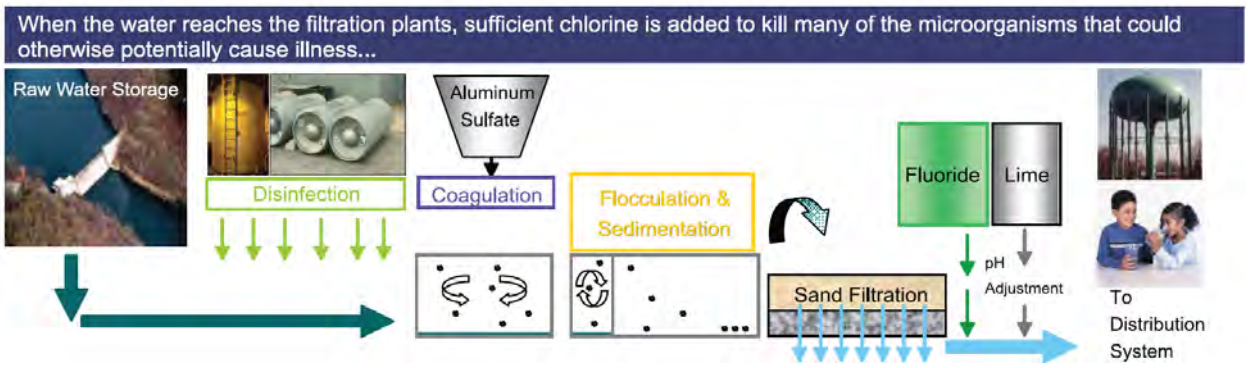

Figure 3.1. Baltimore's Water Treatment Process

Approximately 225 mgd of water is supplied to Baltimore City and surrounding counties. Baltimore City and Anne Arundel, Baltimore, and Howard Counties receive finished water while Carroll and Harford Counties receive raw water. The distribution system serves an area of approximately 560 square miles and contains 20 finished water pumping stations, 8 water towers, 6 storage tanks, 3 finished water reservoirs, 3,800 miles of 3-inch to 12-feet diameter water mains, 700 miles of public water connections and 22,800 fire hydrants. Most of the mains are cast iron pipes, but some of the larger mains are steel or reinforced concrete pipes. Within the network of mains, thirteen major pressure zones within five service levels are maintained to provide adequate water pressure and supply to the consumers.

Under the present operating system, the Montebello WFPs supply water to the First Zone by gravity, and the Second and Third Zones by pumping. The Ashburton WFP supplies water to the Second Zone by gravity, and the Third, Fourth and Fifth Zones by pumping.

3.1.2 Wastewater Infrastructure

The City's sanitary sewer system, much of it built in the early 1900s, collects and treats an average flow of 210 million gallons of wastewater each day through 3,100 miles of sanitary sewer mains and interceptors in the City and Baltimore County. The City is responsible for the 1,400 miles of sewer mains and interceptors within Baltimore City. The City also operates 9 major wastewater pumping stations and 10 minor pumping stations.

Wastewater treatment is provided by the Back River WWTP, which was completed in 1911, and the Patapsco WWTP, which was completed in 1940, but was replaced with a new plant in 1985. The Back River WWTP has an NPDES Permit capacity of 180 mgd and the Patapsco WWTP has an NPDES Permit capacity of 73 mgd.

Wastewater from both Baltimore City and Baltimore County enters the Back River WWTP through two large conduits. The plant provides tertiary level treatment that utilizes fine bubble, air distributed, activated sludge. Phosphorus control is by chemical addition and nitrogen control is by biological processes. Hydraulically, the plant can handle peak flows of over 400 mgd. After treatment, a portion of the effluent is diverted to the Sparrow's Point peninsula for discharge. The remaining effluent passes through a 1,200-foot long outfall structure where it is gradually aerated and diffused into Back River. The City is under contract with a private corporation, Synagro, for solids management. Solids from the facility are dewatered using centrifuges and heat dried to produce a dry pelletized product which is also marketed as a fertilizer. A small percentage is composted. An enhanced nutrient removal ("ENR") system is currently being designed for installation at the Back River WWTP.

The Patapsco WWTP is an advanced secondary treatment facility. Disinfection is by chlorination with de-chlorination by sulfur dioxide. Effluent is discharged to the Patapsco River. Solids from the treatment process are sent to a Synagro heat drying facility where centrifuges dewater the sludge before the cake is converted to pellets in the dryers. The pellets are sold for use as fertilizer, used for land application or disposed of in landfills. A Biological Nutrient Removal ("BNR") and Enhanced Nutrient Removal ("ENR") system is under construction (City Contract SC845) at the Patapsco WWTP specifically to remove nitrogen (approximately 83 percent reduction of nitrogen) and phosphorus (approximately 85 percent reduction of phosphorus) from the wastewater.

3.1.3 Surface Water Infrastructure

The City's stormwater system manages flow from the five watersheds that make up the City: Baltimore Harbor, Back River, Jones Falls, Gwynns Falls and Patapsco River. Each of these watersheds crosses at least one political boundary so the City both accepts flow from neighboring counties and contributes flow to its neighbors as well.

Like many other large, urban communities, Baltimore has a number of urban streams that have been turned from natural drainage ways into paved and channelized streams, or completely covered over as in the case of the Gwynns Falls and Jones Falls tributaries. Further, since the City has been providing stormwater services to its citizens for more than 100 years, many of the City's stormwater facilities, like it's water and wastewater infrastructure facilities, are aging and in need of rehabilitation as evidenced by recent collapsed pipes and sink holes at Race Street and Monument Street.

The basic surface water infrastructure was designed simply to prevent flooding and still serves that purpose today. Newer portions of the system include pollution control facilities and best management practices which reduce the quantity and improve the quality of the stormwater that reaches the receiving waters.

The City's separate storm drain system includes 1,146 miles of storm drain pipes; 27,561 storm drain manholes; 52,438 storm drain inlets; 4 stormwater pump stations (Caroline, Charles Street Center, Colgate and Highlandtown) and 1,709 outfalls. The City also has three debris collector installations (one being redesigned) and a fourth pending design. Further, there are about 350 structural BMPs within the City, with a majority of these installations located on private property.

Trash skimmers are used in the Harbor itself to collect debris, especially Styrofoam and light plastic. Booms and nets have been used to corral the trash, but that can create an unsightly pileup of debris close to shore. More recently, the City has tried to limit the amount of trash entering the Harbor by installing nets across trash-prone storm drain discharges.

3.2 Regulatory Requirements

The Bureau operates under a number of federal and state mandates designed to protect the health and safety of the public and to protect the environment. The following sections summarize the compliance status for the key regulatory statutes.

3.2.1 Water Compliance Status

The City's water treatment, transmission and distribution system must meet the requirements of the Safe Drinking Water Act ("SDWA"). The SDWA is primarily focused on reducing public health risks from contaminants in drinking water. In addition to specific maximum levels for

specified contaminants in the finished water provided by water treatment plants, the EPA requires utilities to implement certain policies and procedures such as source water (i.e., raw water) protection measures. Further, some contaminants are measured at the customer's tap or at remote locations within the distribution system.

Precipitation and snow melt, and the resulting runoff, affects the quality of the water arriving at the City's raw water reservoirs. As water travels over the surface of the land, it dissolves naturally occurring minerals and can pick up substances resulting from the presence of animals or from human activity. Constituents may include: leaves and branches; trash; viruses and bacteria (originating from wastewater discharges, from septic systems, or from natural/wildlife sources); and radioactive constituents (that can be naturally-occurring).

The City's reservoirs not only store water, but also provide natural settling and biological processes that improve the quality of the stored water, reducing treatment costs. However, for natural purification processes to be effective, the reservoirs must be protected to reduce the type and the amount of contaminants entering each reservoir. It is essential that source water protection measures be implemented to protect the reservoirs and contiguous watershed land from outside influences that would adversely affect the natural processes. To that end, the City owns approximately 17,580 acres of watershed property surrounding the three reservoirs that provides a natural buffer zone to maintain good raw water quality.

Following treatment, regulatory standards require the finished water to be free of pathogenic organisms. The City's three filtration plants utilize an overall "multiple barrier" treatment process to remove contaminants during the treatment process. Processes upstream of the filtration process help remove a significant portion of larger particles and other impurities through chemical application and extended detention times in settling tanks. These upstream processes reduce filter loading and extend individual filter run times during the filtration process, assuring that the treatment plants can meet both quantity and quality demands. The rapid sand filtration process purifies the water by sending the water through a sand media filter bed that separates impurities and other suspended solids from the processed water. The amount of suspended solids in drinking water is tightly regulated by MDE. Chlorine is added to the raw water as it enters each plant to kill microorganisms such as bacteria, protozoa and viruses that may cause illness in humans. Chlorine also prevents the growth of algae at the treatment plant that may interfere with treatment of water and cause taste and odor problems. Enough chlorine is added to maintain a residual of 1 part per million ("ppm") in the potable water after filtration. A chlorine residual is needed to prevent re-growth of bacteria in the distribution system. Low levels of chlorine, approximately 0.2 to 1 ppm, must be maintained in the distribution system pipes and home plumbing to prevent the growth of microorganisms.

Fluoridation is added to the filtered water at each filtration plant to reduce tooth decay. The plants maintain fluoride levels of approximately 1 ppm in the treated water.

Lime is added to the treated water before the water is distributed. Lime, or calcium oxide, is added to raise the pH of the water to about 8 standard units. Raising the pH of the water reduces the opportunity to corrode water mains and home plumbing materials such as copper, lead and brass. Corrosive water can dissolve lead and copper, which can be a public health concern, particularly for young children.

As evidenced by the Bureau's annual Consumer Confidence Report,[10] the City's drinking water meets or exceeds EPA's water quality standards.

The Bureau is currently working to meet the Long Term Enhanced Surface Water Treatment Rule ("LT2 Rule") to further reduce the risk of contaminants entering the water distribution system. Water systems such as Baltimore that store finished drinking water in uncovered reservoirs are now being required to either cover these reservoirs or treat the discharge from them to reduce potential contamination from animals, such as birds or insects. The City currently has five uncovered finished water reservoirs that are subject to this regulatory mandate. Towson and Montebello II are under construction and will be finished in 2013 and 2014, respectively. Guilford will be completed in 2016 followed by Druid and Ashburton Lakes, which will no longer serve as finished water reservoirs, but will be replaced with subsurface covered storage tanks. The new tanks are currently planned to be in place by the end of 2018.

3.2.2 Wastewater Compliance Status

The City's wastewater treatment and collection system is regulated by the Clean Water Act ("CWA"). National Pollutant Discharge Elimination System ("NPDES") permits are issued by the State of Maryland governing the amount of pollutants authorized for effluent discharge to receiving waters. Any other discharges from the wastewater system are considered unpermitted discharges and are a violation of the CWA. The NPDES permits also require proper operation and maintenance of both the treatment plants and the collection systems.

The City's two wastewater treatment plants, Back River and Patapsco, have minimal excursions of their respective NPDES permit. Effluent discharges are regulated for biochemical oxygen demand ("BOD"), total suspended solids ("TSS"), nitrogen, phosphorus, dissolved oxygen, pH and effluent toxicity parameters. Occasional excursions of effluent limits occur at each plant during peak wet weather periods, which are quickly resolved and the plants return to compliance.

Water quality in the Back River, however, remains impaired for nutrients. In 1998, Biological Nutrient Removal ("BNR") process upgrades were completed at the Back River WWTP to achieve nitrogen and phosphorus limits of 8 mg/l and 2 mg/l, respectively and enabled the plant to further reduce nutrient loadings to Back River. The plant had been achieving low effluent total phosphorus levels through chemical addition. However, legacy phosphorus pollution from historic early plant discharges and from multiple non-point sources solubilizes from the sediment as the pH rises during times of peak biological activity. These two sources provide sufficient nutrients to support the algal growth still observed in the Back River throughout the growing season.

These issues are being addressed as part of the overall Chesapeake Bay restoration strategy and also as part of the necessary steps to improve local water quality conditions in Back River. Currently facilities are under design to take the Back River WWTP to enhanced nutrient removal ("ENR") levels. When these facilities are completed and operating efficiently, effluent total nitrogen concentrations will be on the order of 3 to 4 milligrams per liter ("mg/L") rather than the 7 to 8 mg/L currently discharged. Additionally, phosphorus will be reduced to meet permit limitations of 0.2 mg/l on a monthly average and 0.3 mg/l on a weekly average. This will reduce by approximately half the concentration and therefore loadings from the plant to Back River.

[10] Baltimore City Department of Public Works, *City of Baltimore Annual Water Quality Report*, Reporting Period: January 1, 2011, to December 31, 2011.

Unlike the relatively minor nature of NPDES violations at the treatment plants, the collection system previously had a number of constructed sanitary sewer overflows, several of which routinely activated during storm events. Two areas of the City, Forest Park and Walbrook, were served by combined sewers (i.e., pipes that transported both stormwater and sewage). The constructed SSO activations, overflows from other parts of the separate sewer system and overflows from the combined sewer systems, were considered unpermitted discharges and thus constituted a violation of the CWA.

In September 2002 the City entered into a Consent Decree with the U.S. EPA, U.S. Department of Justice ("DOJ"), and the State of Maryland Department of the Environment ("MDE"). Under the terms of the Consent Decree, the City is required to:

- "Eliminate" sanitary sewer overflows ("SSOs") and combined sewer overflows ("CSOs");
- Complete a comprehensive sewer evaluation program;
- Complete a comprehensive sewer rehabilitation program; and
- Implement continuous upgrades to operation and maintenance ("O&M") programs.

The Consent Decree established specific compliance dates between 2002 and the ultimate compliance date of January 1, 2016.The original estimate of the cost of compliance with the Consent Decree was $1 billion.

As of the end of 2011, the Bureau has successfully eliminated 60 of 62 of the constructed SSO structures, requiring 39 projects amounting to 29 miles of sewer rehabilitation and 10 miles of new/replaced sewers. Additionally, the Jones Falls Pumping Station was upgraded from 35 to 55 mgd; a new 20 mgd Stony Run Pumping Station was completed; and the combined sewers in Forest Park and Walbrook were separated.

A comprehensive sewer evaluation program has been completed. This program included:

- Inspection of over 33,000 manholes;
- Closed circuit television ("CCTV") inspection of over 1,100 miles of 8-inch and larger diameter sewers;
- Resolution of all emergency repairs identified during the inspection program;
- Update of the City's Geographic Information System ("GIS") with inspection findings;
- Development of an hydraulic model for each sewershed and combination of these micro models into a citywide comprehensive macro model;
- Completion of a comprehensive rainfall and flow monitoring program and I/I evaluation;
- Development of various levels of CIP capacity improvement projects and associated cost estimates; and
- Submittal of sewershed plans detailing the above activities to U.S. EPA Region III and MDE.

The City's investment in Consent Decree-related projects and activities is already over $500 million. The City continues to work with EPA and MDE to define additional capacity-related improvements for the collection system.

While the Consent Decree focuses on the City's wastewater collection system, it included a Supplemental Environmental Project (SEP) to implement enhanced nutrient reduction

improvements at the Patapsco WWTP in an effort to reduce the nutrient loadings into the Chesapeake Bay. With the completion of these ENR facilities and other wastewater treatment facility capital investments for NPDES permit compliance and Chesapeake Bay Restoration mandate, the City's investments to date are nearly $1 billion.

3.2.3 Surface Water Compliance Status

The CWA also governs the Bureau's surface water activities under the terms of the City's Municipal Separate Storm Sewer System ("MS4") permit. Under the City's 2005 MS4 Permit, which was administratively extended upon its expiration in 2010, the City is required to monitor streams, storm drains and the Harbor. The City relies on ammonia screening and stream impact sampling, two water quality monitoring programs run by the Water Quality Monitoring and Inspection Section, to detect illicit connections to the stormwater infrastructure and to initiate Pollution Source Tracking to remove those illicit connections. The City's goal is to visit each of the 37 stream impact sampling stations once per month and each of the 47 ammonia screening stations weekly.

The CWA obligates the City to fund projects to reduce pollutant discharges under Total Maximum Daily Load ("TMDL") allocation limitations. These wasteload allocation studies establish limitations on pollutant discharges based on water quality of the receiving waters. Approved TMDLs applicable to Baltimore City include:

- TMDL of Sediment in the Patapsco River Lower North Branch Watershed, Baltimore City and Baltimore, Carroll, Howard and Anne Arundel Counties, Maryland (September 30, 2011).
- TMDL of Sediment in the Jones Falls Watershed, Baltimore City and Baltimore County, Maryland (September 29, 2011).
- TMDL of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore, County, Maryland (March 10, 2010).
- TMDL of Fecal Bacteria for Lower North Branch Patapsco River Watershed in Baltimore, Carroll, Anne Arundel, Howard Counties and Baltimore City, Maryland (December 3, 2009).
- TMDLs of Fecal Bacteria for the Non-Tidal Jones Falls Basin in Baltimore City and Baltimore County, Maryland (February 12, 2008).
- TMDLs of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland (December 17, 2007).
- TMDLs of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, MD (December 4, 2007).
- TMDLs of Fecal Bacteria for the Herring Run Basin in Baltimore City and Baltimore County, MD (December 4, 2007).
- TMDLs of Phosphorus and Sediments for Loch Raven Reservoir and TMDLs of Phosphorus for Prettyboy Reservoir, Baltimore, Carroll and Harford Counties, Maryland (March 27, 2007).
- TMDLs of Nitrogen and Phosphorus for the Back River, Baltimore City and Baltimore County, Maryland (June 29, 2005).

- TMDL for Chlordane in Lake Roland, Baltimore County, Maryland (March 23, 2001).
- TMDL for Chlordane in the Baltimore Harbor, Baltimore City, Maryland (March 20, 2001).
- TMDL of Chlordane for Back River, Baltimore County, Maryland (December 17, 1999).

Additional TMDL wasteload allocations are anticipated as EPA and MDE complete further water quality studies.

While the SWMD has met regulatory requirements to date, by 2025 the City will be required to significantly reduce the amount of pollutants entering the areas receiving waters to comply with the MS4 permit and TMDL allocations.

It is anticipated that the City's new MS4 permit will require restoration of 20 percent of the impervious area within the City's permit area. This restoration goal, which is equivalent to over 4,700 acres, will theoretically achieve the 2017 Interim goals of the Bay TMDL program. At present there are approximately 350 structural BMPs within the City, most of which are located on private property. Upgrading these existing BMPs to increase treatment capacity and nutrient reduction is not considered a feasible option to meet the restoration goal. Instead, restoration efforts will be achieved by implementing a combination of new projects as follows:

- About 20 percent by traditional structural BMPs such as bioretention areas, surface filtration systems, wet ponds and wetland areas;
- About 15 percent by impervious area removal through reforestation, urban tree planting and the use of alternative surfaces, such as green roofs and permeable pavement;
- About 10 percent Environmental Site Design ("ESD") treatment practices, such as micro-practices; and
- The remaining 55 percent by non-traditional BMPs, such as stream restoration, inlet cleaning, street sweeping and other practices.

The City will use a similar approach to achieve the remaining goals for 2025; however, the distribution of methods will change in anticipation of limited opportunities for structural, traditional BMPs and stream restoration projects.

On September 4, 2008, EPA Region III approved listing the Baltimore Harbor as impaired for trash/debris/floatables. This action set the stage for development and implementation of TMDLs that will result in the reduction of trash entering the Harbor.

The City's current trash interceptor locations include:

- Alluvion Street Debris Collector – Middle Branch
- Briarclift Debris Collector – Dead Run
- Gwynns Run Pollution Control Facility (in redesign) – Gwynns Run

An additional trash interceptor location is the Bush Street Debris Collector – Middle Branch and is currently in design.

3.3 Infrastructure System Status

The following subsections summarize the current status of the primary water, wastewater and surface water assets.

3.3.1 Water Facilities and Utilities

The Montebello I and II WFPs, were placed into service in 1915 and 1926, respectively. The City's "new" Ashburton WFP was placed into service in 1956.

Under the City's long term master plan, a new water filtration plant will be constructed. This new filtration plant, Fullerton WFP, along with an expansion of the Montebello filtration plant and the use of Susquehanna River as a regular raw water source, is expected to meet projected water treatment needs of the regional service area.

The proposed Fullerton WFP will treat raw water from the Susquehanna River utilizing membrane filtration as part of the treatment train. Membranes are very thin hollow tubes which allow water to pass through while retaining extremely small particles ensuring that very high water clarity can be achieved. The membrane process is more suitable for raw water that can change quality very quickly, such as the Susquehanna River water, but can be more expensive than more conventional treatment schemes.

Finished water is delivered to customers through the City's water transmission and distribution system comprised mostly of cast iron pipes. The average age of the pipes in the distribution system is about 80 years. Although age itself does not render a pipe useless, the pipe can weaken over time so that when the surrounding soil shifts and support is lost, the pipe breaks. Breaks are especially common during the freeze-thaw periods of winter when hundreds of breaks must be addressed. In recent years, the City has experienced an increase in non-seasonal breaks as well. In some cases, these breaks have caused significant damage and disruption of services to Baltimore City and Baltimore County residents.

O&M and CIP funding have largely been devoted to reactive activities that respond to these breaks and associated leaks. Current preventive maintenance activities include leak detection, valve and hydrant exercising and assessment, and transmission main condition assessment. A greater effort and investment is needed to include other preventive maintenance activities such as system wide flushing and comprehensive pipeline condition assessment activities. Furthermore, with the emphasis on responding to breaks and leaks, customer complaints associated with color, taste or odor occurrences are addressed by temporary water main flushing solutions rather than through a "root cause" analysis that could lead to a corrective action such as rehabilitation or replacement that would be funded by a CIP project.

CIP funding has also been diverted to achieve compliance with the LT2 Rule. To date, the City has spent over $10 million on designing and constructing covered tanks to replace open finished water reservoirs and anticipates spending a total of over $118 million before the projects are complete in 2018.

3.3.2 Wastewater Facilities and Utilities

With the emphasis on Consent Decree compliance since 2002, the Bureau has invested significant O&M and CIP funds on both the Wastewater Facility infrastructure (i.e., plants and pumping stations) and the Wastewater Utilities (i.e., sewers and manholes).

Various upgrades are completed or underway at the wastewater treatment plants to reduce nutrient loading to the receiving waters. The plants are largely meeting existing effluent limitations. Almost 50 percent of the influent flow to the City's wastewater treatment plants is generated in Baltimore County. The County is under a similar SSO-focused consent decree with EPA and MDE. Therefore, the expansion needs evaluation must consider the planned improvements in the Baltimore County collection system.

With the completion of the system wide collection system evaluation, multiple sewer rehabilitation projects have been identified and are in varying stages of completion, from design through construction. Some collection system capacity improvement projects have already been completed, but numerous others will be defined based on hydraulic modeling results and collaboration with state and federal regulatory agencies on the appropriate level of protection for Baltimore.

3.3.3 Surface Water Facilities and Utilities

To date, the SWMD has been limited in the amount of CIP funding available. The SWMD has attempted to maximize its limited financial resources by working with other governmental agencies within the watershed. For example, the Baltimore Watershed Agreement formalizes the commitment of Baltimore City and Baltimore County to work together on the management and monitoring of shared watersheds. This agreement was first signed in 2002 and renewed in 2006. The agreement acknowledges that geographic boundaries of watersheds are more appropriate for managing these important natural resources than political boundaries.

The new Stormwater Management Plan ("SMP") will focus on supplementing the "baseline" services listed in Subsection 3.1.3 above, increasing the City's surface water infrastructure level of service. The City will increase operating efforts in order to comply with its anticipated more stringent MS4 permit, especially in regards to maintenance of the new stormwater best management practices. The costs associated with MS4 permit compliance are expected to more than triple by the year 2020, and exceed $40 million in 2017. Capital project implementation will increase as well, as the City undertakes projects to improve surface water quality and replace essential components of the aging drainage system.

Many of these projects are contingent on the implementation of the stormwater remediation fee, required by State law to be in place by July 2013. The fee will be based on a property's impervious area and charged to all private and federally-owned properties. On November 6, 2012 the Baltimore City electorate approved a measure to amend the City Charter to create a stormwater utility enterprise fund.

Customers will have the opportunity to decrease their stormwater fees by participating in stormwater management efforts such as stream clean ups or by implementing BMPs to decrease stormwater runoff or improve stormwater quality. The City is working with a citizens committee to refine the details of this planned credit program.

As part of its watershed focus, the SWMD has developed a watershed plan aimed at reducing trash, increasing green space, creating more natural hydrology and improving the livability of the community. The eligible BMPs, approved by the Chesapeake Bay Program, are limited and expensive in their applicability to urban environments such as Baltimore. The available BMPs focus on stormwater treatment and runoff reduction, but not pollution prevention. To offset some of the significant cost of the City's TMDL Phase II WIP Strategy, the City will participate in research to quantify the nutrient and sediment removal efficiencies of new, non-traditional BMPs, which include, but are not limited to:

- Debris collection systems;
- Dry sweep programs;
- Education;
- Eroded slope stabilization;

- Illicit discharge disconnection and elimination (“IDDE”);
- Infrastructure replacement (I/I cross-migration between utility pipes);
- Leaf collection programs;
- Outfall stabilization;
- Pet waste management programs;
- Soil amendments (subsoiling);
- Vacant lot management; and
- Vehicle trip reduction.

These practices will be integrated throughout Baltimore neighborhoods: at schools and recreation centers, in vacant or abandoned lots, in parks, and along the sidewalks and roadways. In addition to improving the surface water quality, these practices will also help improve public safety, address health issues like asthma, restore the natural habitat, decrease energy needs and greenhouse gases, provide alternative solutions for irrigation needs (water consumption), provide neighborhood beautification, and create both short- and long-term job markets for constructing and maintaining these practices.

4 UTILITY CHALLENGES

4.1 Water Infrastructure

The Bureau is planning significant CIP expenditures to design and build a new water treatment plant. The proposed new Fullerton WFP will supplement the regional water supply and allow sufficient redundancy in the water system to make needed renovations to existing water treatment facilities. Additionally, the Bureau is implementing plans to replace open finished water reservoirs that store potable water prior to its being pumped into the transmission and distribution system with closed tanks. Taking the open reservoirs out of commission is required by the Safe Drinking Water Act (under the LT2 Rule) to minimize opportunities for possible contamination while the water is being stored.

While the Bureau provides high quality, potable water to its customers, the Bureau has not yet had the ability to consistently and sufficiently invest in the water distribution system. As a result, water mains selected for rehabilitation or replacement are those with a history of breaks, leaks and complaints of discolored or low pressure water. A reactive capital improvement program does not provide the best and most cost effective utility management practice. Without a fully funded, systematic and proactive investment strategy, water main breaks will continue to cause customer service disruptions, impact surface waters and divert much need funds to more costly emergency measures.

4.2 Wastewater Infrastructure

Baltimore wastewater infrastructure has been subject to an EPA/MDE SSO Consent Decree since 2002. The City is currently in negotiations with EPA and MDE to define the level of protection to which the system must be built. Once the appropriate level of protection and the design criteria are agreed upon, the 2002 Consent Decree may need to be modified and the compliance date extended.

Further, once the design flows from the collection system and from the Baltimore County collection system are known, the possible need for additional peak wet weather storage at the wastewater treatment plants must be evaluated. The required collection system improvements in both systems will result in additional sewage being retained within the system rather than being discharged as SSOs.

While the Consent Decree addresses a number of the larger rehabilitation and replacement projects, the Consent Decree does not require complete replacement of the system. As the subsurface wastewater utilities continue to age, rehabilitation and replacement will be an additional capital investment need.

The Consent Decree addresses deficiencies of the collection system. However, the system wide hydraulic model of the two wastewater collection systems identified a significant hydraulic restriction at the Back River WWTP that needs to be addressed as part of the SSO reduction corrective actions. It is also expected that increasingly stringent effluent limitations will arise in the future that could require upgrades and possibly additional treatment facilities at either or both the Back River and the Patapsco WWTPs. Additional effluent limitations could also be added in the future to comply with TMDL waste load allocations.

4.3 Surface Water Infrastructure

Historically, the City of Baltimore has provided street-related stormwater services, specifically managing storm drainage systems. In order to decrease roadway flooding and protect public safety, the City must significantly increase its level of these services. However, the cost of doing so effectively is high due to aging infrastructure that is requiring more frequent and extensive repair, rehabilitation and replacement. Recent infrastructure failures have caused road collapses, significant roadway flooding and consequent threats to public safety. An example is the collapse of a 120-year old storm drain tunnel under East Monument Street, which resulted in full roadway collapse and evacuation of residences and businesses.

In addition to the service requirements associated with flooding, stormwater pollution control requirements have expanded as the regulatory framework has changed drastically in recent years. It is not enough to focus on the quantity of water transported by the City's system; the quality of the water that is discharged into receiving streams, the harbor and, ultimately, the Chesapeake Bay must also be accounted for. More stringent environmental regulations are the single greatest driver causing stormwater management costs to increase. The City must comply with its MS4 permit. Under the upcoming permit issuance, the MS4 permit doubles previous impervious area restoration goals, with a requirement to control runoff from 20 percent of uncontrolled impervious area within the next five years. The new permit will also require the implementation of trash reduction strategies, the improvement illicit discharge detection and elimination ("IDDE") operations, and the expansion of public outreach and education programs. Each of these legal requirements is costly to meet, and funding is not provided by the state or federal government.

Upon implementation of the SMP, the City will focus efforts on a variety of projects, including:

- Stream restorations in the Stony Run, Chinquapin Run and Biddison Run sub-watersheds;
- Environmental site design ("ESD") project implementation in the Cherry Hill and Butcher's Hill neighborhoods;
- Facility greening projects at local schools and interior parks; and
- Preventive measures beginning with the installation of inlet screens that capture pollution through the City's gateway corridors.

These projects are not effective without a working conveyance system, so the City will also focus on major infrastructure projects, like replacement of the collapsed Race Street tunnel that has caused a three-year road closure. Where feasible, the City will undertake public-private stormwater system projects. These partnerships can stretch budget dollars and result in multifaceted improvements to the City, reaching well beyond a simple drainage "fix."

The City is shifting drainage maintenance processes from being reactive to proactive, enabled by a new asset management system for the inlets, manholes, and more than 1,000 miles of drainage pipe in Baltimore. Proactive maintenance is more cost effective, as it identifies problems quickly and addresses them systematically, often minimizing damage resulting from infrastructure failures. The program also incorporates a greatly expanded urgent needs component to quickly address future drainage system failures that will certainly occur. Improved drainage maintenance will help us keep the City's street network in better condition, reducing potholes, street closures and impacts on other utilities.

The proactive drainage maintenance, capital project construction and regulatory compliance efforts mentioned above will require increased staffing at Baltimore City. The SMP will create more than 70 new permanent jobs by 2015, and over 120 jobs by 2017. These new employees will be engineers, scientists, inspectors, technicians and drainage system maintenance staff. The increased staff will also include our Watershed Liaison Office to facilitate public participation in project implementation, in addition to our monitoring and inspections staff to improve regulation enforcement.

4.4 Water Quality Challenges

Many of Maryland's receiving streams, including the Inner Harbor and the Chesapeake Bay, are degraded and are listed as impaired, especially for nutrients, sediment and toxics loadings. However, in addition to the City's urban pollutant sources, pollutants enter these water bodies from agricultural land uses outside the City and from legacy pollution in the sediments. These issues are being addressed as part of the overall Chesapeake Bay restoration strategy that requires improvements to water quality conditions in local water bodies. All pollutant contribution sources, point source and nonpoint source alike, will require large investments to implement prevention and control measures before there will be measurable water quality improvements in the Inner Harbor and Chesapeake Bay.

The City is implementing numerous programs and improvements designed to eliminate or attenuate pollutant discharges through SSO reduction and surface water BMPs. As with most large cities, Baltimore faces the challenges associated with aging infrastructure, a highly urbanized environment and limited financial resources.

The City faces significant financial challenges in meeting not only existing, but anticipated future TMDL-related waste load allocations and more stringent permits.

Over time, the City expects that its various corrective actions and improvement projects will make significant contributions to improving water quality in the Inner Harbor, the Chesapeake Bay and receiving streams.

4.5 Human Health Threat Challenges

The City has not received any reports of human illness attributable to its water, wastewater or surface water infrastructure. However, the City does approach all situations where there may be a potential threat to human health or safety by either correcting the situation or managing the associated risk.

The EPA has determined that a potential human health risk may exist because portions of the City's potable water is stored in five open finished water reservoirs located in Baltimore City and County. The City is addressing this potential risk by either covering the reservoirs or installing covered storage tanks.

Similarly, there is a low risk for possible contamination from the City's lengthy distribution mains. Maintaining consistent residual chlorine levels and adequate flow in the pipes reduces the opportunities for organisms to grow in the distribution system. When pre-indicators, such as color, taste or odor complaints are received from customers, Bureau crews respond by flushing the mains to increase flow velocity and bring new, fresh water with higher chlorine residual levels into the affected sections of the main. A more sustainable solution would be to implement a unidirectional flushing program to maintain a high quality of water throughout the system. A more permanent solution, where appropriate, would be to rehabilitate the main by lining the pipe

or by replacing the main with a new pipe. With the limited water system budgets in recent years, the City has had to rely on the periodic, temporary flushing solution.

Another common potential health threat associated with water distribution systems is the lead contamination in drinking water. Lead is more commonly introduced into a customer's home by lead solder in older plumbing on service lines and inside the buildings. The City is in compliance with state and federal regulations relating to lead contamination. Every three years the City is required to sample at least 50 sites for lead contamination. During the most recent sampling performed in 2012, none of the sites exceeded the action level threshold of 15 parts per billion ("ppb"). Of the 52 sites sampled in 2012, the 90th percentile for lead was 5.38 ppf. In addition, the City issues an annual Water Quality Report that is mailed to all water customers and is posted on the City's website. The report details the EPA-required water quality parameters for drinking water and compares those parameters with City water testing results. Baltimore's drinking water consistently meets or exceeds the EPA standards.

No health problems have ever been reported as a result of the City's wastewater treatment facilities or sewer collection system. The EPA considers SSOs from the collection system to be a potential health risk. The City minimizes the potential for health problems by restricting public access and by notifying the Health Department when an SSO has occurred at a particular location. The Bureau is implementing capacity improvements to reduce the number of wet weather related SSO events and instituting improved asset management-focused O&M policies, practices and procedures to reduce the number of dry weather SSO events. The challenge for the Bureau is to manage and balance a limited budget that moves the Bureau into a more asset-management focused, proactive O&M program for its entire infrastructure portfolio, while addressing the pressures of a highly regulated and aging infrastructure.

There is little potential for adverse human health impacts due to the City's surface water system with perhaps the rare exception of threats to human life during extreme flooding situations when stream flows may increase and cause roadways or bridges to collapse. The City has also experienced a few storm sewer collapses and sink hole occurrences due to its aging storm sewer infrastructure. The City minimizes such risks by blockading flooded and collapsed roadways.

5 INTEGRATED PLANNING FRAMEWORK MODEL DEVELOPMENT

5.1 The IPF and Sustainable Decision Making

Integrated planning results in "the identification of sustainable and comprehensive solutions, such as green infrastructure, that improve water quality as well as support other quality of life attributes that enhance the vitality of communities."[11] In order to ensure that decisions (anything from operations to infrastructure investments) are made in a sustainable manner, utility decision makers and regulators must consider more than the traditional, single parameter analysis of financial performance. Following sustainable practices means accounting for entire system implications of alternatives, both costs and benefits, in economic, social and environmental terms. This is commonly referred to as the Triple Bottom Line ("TBL"). While TBL is increasingly being used for integrated evaluations, there is no fixed methodology and the techniques used can vary widely in how it is applied.[12]

5.2 Selecting a TBL Scoring Method

Successful TBL projects typically employ some type of decision analysis framework. It is a significant challenge to compare the relative values of each TBL category, because each is traditionally measured using different metrics. For example, economic criteria may be measured in monetary units while environmental criteria may be measured in concentration of pollutants removed. Decision analysis methods, also known as multi-criteria analyses, can be used in such situations and provide the following advantages.

- A logical framework for making decisions based on what is known and not known (fact and uncertainties), what options exist (alternatives) and what preferences exist (values); and
- Enable individuals and groups to efficiently review how various changes to options and preferences impacts overall priority results.

Decision analyses allow comparison of complex tradeoffs and incorporation of stakeholder preferences. The foundation for the City's IPF allows the comparison of options in terms of capital costs, technical feasibility, schedule, environmental impacts, health and social implications, and other parameters that the City and stakeholders consider relevant.

There are several established methods for TBL accounting:

- **Monetized**: in this method, all criteria are converted to a monetary unit value, typically the dollar. This method can be controversial as assigning certain valuations to such things as ecosystem protections, can be difficult to quantify. Other values, such as the monetary value of emissions, may be taken from the nearest market pricing, but in cases of immature or poorly structured markets, this may vastly devalue the actual cost. Hedonic pricing, based on statistical polling of value opinions is often used to place a monetary figure on social benefits such as the benefit of having green space in the neighborhood. There is no one single agreed-upon methodology for monetization. The

[11] U. S. Environmental Protection Agency, *Achieving Water Quality Through Municipal Stormwater and Wastewater Plans,* October 27, 2011. Available at http://cfpub.epa.gov/npdes/integratedplans.cfm.

[12] For more information on the definition of TBL and how it is used, visit: http://www.ibrc.indiana.edu/ibr/2011/spring/article2.html.

recently developed Sustainable Return on Investment method is recommended by the Clinton Global Initiative.[13] The City of Philadelphia's Watersheds CSO project uses a separate monetization methodology.[14] The major advantage of monetization is that it results in a single unit with which to compare all criteria within and across all TBL categories. The drawbacks are that it can be time consuming and costly and it can be difficult to explain and gain consensus from community stakeholders.

- **Score-Based Quantification**: In this method all criteria within the TBL categories are scored individually with appropriate corresponding units. No subsequent monetization occurs. However, in order to compare all criteria within and across the TBL categories, the criteria values must be translated to a score. There is no single agreed-upon methodology for score-based quantification; however, several cities have pioneered this as a starting point for TBL analyses. The advantages of score-based quantification are that it provides a single unit for comparing criteria across and within the TBL categories; it is relatively easy to develop; it can be customized to accommodate the specific needs and conditions of a local community and utility; and it may be easier for stakeholders to accept. The drawback to score-based quantification is that there is no single agreed-upon standard for quantification.

- **Points-Based Quantification**: This method does not employ a true TBL approach; the TBL concept is adapted to the type of infrastructure being evaluated. Points-based quantifications are used primarily for evaluating the relative "greenness" of sustainability of projects and awarding a rating (e.g., gold, silver, bronze) to the infrastructure project. The most notable implementations of points-based quantification are the LEED Green Building standard[15] and the Harvard method that resulted in the creation of the Institute for Sustainable Infrastructure.[16] In points-based quantification, multiple evaluation categories with defined performance levels are established. Infrastructure projects are awarded points based on the performance level they achieve for each performance criterion. The advantages of using an established points-based quantification system are that the process is relatively transparent and may be easy to explain to stakeholders. The drawbacks are that the categories and criteria are fixed and may not be appropriate for the specific infrastructure needs of a given utility and that the limited criteria performance levels may not be nuanced enough for a true understanding of the merits of a project or set of projects.

Each of these TBL methodologies was discussed to determine the best approach for the IPF process. The Score-Based Quantification method was chosen because it can be customized for the TBL criteria chosen by the City and it is relatively simple in comparison to monetization. The method for developing individual criteria and scoring projects is discussed later in this section.

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13 Clinton Global Initiative, HDR Inc. and Columbia University School of International and Public Affairs, *Sustainable Return on Investment,* 2009. Available at http://sipa.columbia.edu/academics/workshops/documents/CGIBrochureupdated.pdf.

14 Stratus Consulting, Inc. *A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds,* August 24, 2009. Available at http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_philadelphia_bottomline.pdf.

15 For more information on LEED and the US Green Building Council, refer to http://new.usgbc.org.

16 For more information on the Institute for Sustainable Infrastructure, refer to http://sustainableinfrastructure.org/index.cfm.

5.3 The IPF Model Development and Process

The IPF model has been designed to be an iterative process, with key process steps as shown in Figure 5.1 and further explained in subsequent sections.

Figure 5.1. IPF Process Diagram

Step 1 – Project List. The project list includes water, wastewater and surface water projects that are to be included for prioritization purposes.

Step 2 – Prioritization Criteria. These are the TBL criteria by which the projects are evaluated.

Step 3 – Project Scores. Projects are scored with respect to each prioritization criteria.

Step 4 – Scenario Development. A set of scenarios that represent different assumptions and inputs for comparison purposes is developed.

Step 5 – Importance Weighting. Importance weighting factors are assigned for each criterion to reflect the relative importance of that criterion as compared to the others.

Step 6 – Weighted Total Scores. The total weighted scores determine the prioritized ranking of projects.

Step 7 – Cost/Benefit & Full Financial Analysis. The prioritized ranking according to the scheduling model and the financial analysis defines how much the City can budget in each year to complete the prioritized projects.

Step 8 – Involve Stakeholders. Define and engage key stakeholders in the process to review assumptions, inputs and results.

Step 9 – Select Final Scenario. Identify the appropriate scenario based on model and analysis outputs.

Step 10 – Finalized Integration Plan. Based on the financial analysis of the selected scenario, projects are scheduled in accordance with the City's anticipated yearly financial capacity.

Step 11 – Monitoring Success. Utilize an adaptive management approach to test, monitor and evaluate progress making adjustments as necessary.

Step 12 – Revised Analysis As-needed. It is intended for this process to be repeated on an iterative basis as frequently as necessary to provide benefit to the City.

To support the IPF process, data and qualitative information were compiled from a diverse set of sources and methods including detailed review of project and policy documents, interviews between the City and the MWH-LBWS Joint Venture Program Management Team ("PMT"), and workshops with the City and the PMT.

5.4 IPF Project List

The IPF Project List contains the projects that the City needs to undertake in order to achieve operational and service goals. The IPF Project List is divided into three general types of projects:

- Projects included in the City's Fiscal Year ("FY") 2013 CIP.
- Annual recurrent capital and O&M projects.
- Additional projects generated from interviews and previous reports or studies.

For each project, the primary data obtained were:

- Project name;
- Project identification number, if available;
- Description, rationale and justification for the project;
- Project type (i.e., wastewater facility, wastewater utility, surface water facility, surface water utility, water facility, and water utility);
- Project cost by fiscal year, from FY13 to FY24 and total project cost;
- City share, County share, and grant share of total project cost;
- Project start and completion dates;
- Identification of regulatory compliance projects and Consent Decree projects; and
- Source(s) of available information on this project, including available background data.

The IPF Project List totaled 556 distinct projects. To facilitate data management, these 556 projects were "bundled" into 153 projects as summarized in Table 5.1. Complete project listings are presented in Table A.1 of Appendix A with the bundled projects presented in Table A.2 of Appendix A. Generally, projects were bundled as a single project if they encompassed different development phases of the same project. For example, the feasibility, full design and construction phases of a wastewater facility would be considered a single project under this approach.

Table 5.1. Baltimore IPF Project List Summary

Bureau Section	Total Number of Projects	Bundled Number of Projects	Estimated Cost (million dollars)
Water Facilities	176	46	$ 1,858
Water Utilities	114	18	1,222
Wastewater Facilities	137	35	1,592
Wastewater Utilities	84	16	1,172
Surface Water Facilities	33	26	208
Surface Water Utilities	12	12	316
Totals	**556**	**153**	**$ 6,368**

In addition, projects with related CIP numbers were bundled where appropriate. For example, freshwater reservoir projects located in the same watershed were bundled into single projects. Projects located in different watersheds or, in the case of wastewater projects, different sewersheds, were not bundled. This is because projects located in different locations are likely to generate different types and levels of benefits and would have different project benefit scores. An additional exception to the bundling method was to separate the Wet Weather Program Operation and Management CIP Project 551-627 into two components: those projects that would directly impact SSO reduction and those that only indirectly impact SSO reduction. These components were separated to better quantify the environmental benefits associated with pollutant removal due to the reduced number and volume of SSO events.

The schedule for a given bundled project was based on the earliest start date/latest finish date from the individual projects assembled into each bundle.

5.5 Prioritization Criteria Development

To compare projects for prioritization purposes, a set of evaluation criteria was initially developed using the TBL approach, whereby benefits are categorized according to social, economic and environmental impacts. The TBL approach was modified for this IPF by adding a fourth evaluation category referred to as Project Delivery criteria. Accordingly, the IPF analysis used a “quadruple bottom line” (“QBL”) approach that included the following four categories:

- **Environmental** includes criteria that characterize impacts to the natural environment particularly as related to pollutants released to receiving water bodies. Criteria also include impacts on natural features such as wetlands, riparian zones, streambeds, forests and open space.
- **Social** includes criteria that characterize impacts to communities including such things as public health impacts, residential property value impacts, access to green space and recreational areas, customer satisfaction and neighborhood health considerations.
- **Economic** includes metrics of financial performance, jobs created and asset life cycle cost implications.
- **Project Delivery** includes project characteristics related to utility service and asset condition, impacts of project delay and the extent of project collaboration with other agencies and stakeholder groups.

The purpose of QBL criteria is to enable a relatively objective bottom line comparison of the benefits of one project against another.

Prior to selection, many potential evaluation criteria were reviewed from the growing number of sustainability rating systems and from available literature on the benefits of green infrastructure and low impact development ("GI/LID"), also known as Environmental Site Design ("ESD"). Sources reviewed included the Institute for Sustainable Infrastructure ("ISI'), the Global Reporting Initiative, EPA's literature on green infrastructure, TBL assessments implemented by other utilities, and the City's priorities for community and economic development and sustainability. The PMT reviewed these resources to develop a list of criteria for consideration by City staff. Through a series of workshops and additional conversations with City staff, an agreed set of evaluation criteria were determined. During this process step, feedback from the staff about the criteria, primarily relating to measuring the benefits associated with each criterion, was incorporated to yield the resulting evaluation criteria list.

The current evaluation criteria list includes the 21 criteria as shown in Table 5.2 below. The evaluation criteria encompass eight Environmental, six Social, four Economic, and three Project Delivery criteria. The QBL criteria types are color coded in blue, pink, green and purple for ease in identifying the type of criteria being scored.

Table 5.2. Benefit Evaluation Criteria

Environmental	Social	Economic	Project Delivery
Pollutant Loading to Receiving Waters – Pathogens	Health and Safety	Alternative Funding	Service Life/Condition
Pollutant Loading to Receiving Waters – Phosphorus	Recreational Access	Annual O&M Costs	Project Delay
Pollutant Loading to Receiving Waters – Nitrogen	Urban Tree Canopy	Job Stimulus	Collaboration
Pollutant Loading to Receiving Waters – Sediment	Customer Satisfaction	Capital Costs	
Pollutant Loading to Receiving Waters – Trash	Drinking Water Quality		
Regulatory	Lower Income or Blighted Areas		
Habitat Preservation and Restorations			
Drinking Water Conservation and Control			

It is anticipated that the evaluation criteria will be reviewed and updated on a periodic basis to reflect evolving City priorities.

5.6 Project Scoring

To score the projects for evaluation, a protocol was developed to promote consistency and accuracy of information collected from various sources. Figure 5.2 shows the process used for obtaining data and then scoring projects considered in the IPF evaluation.

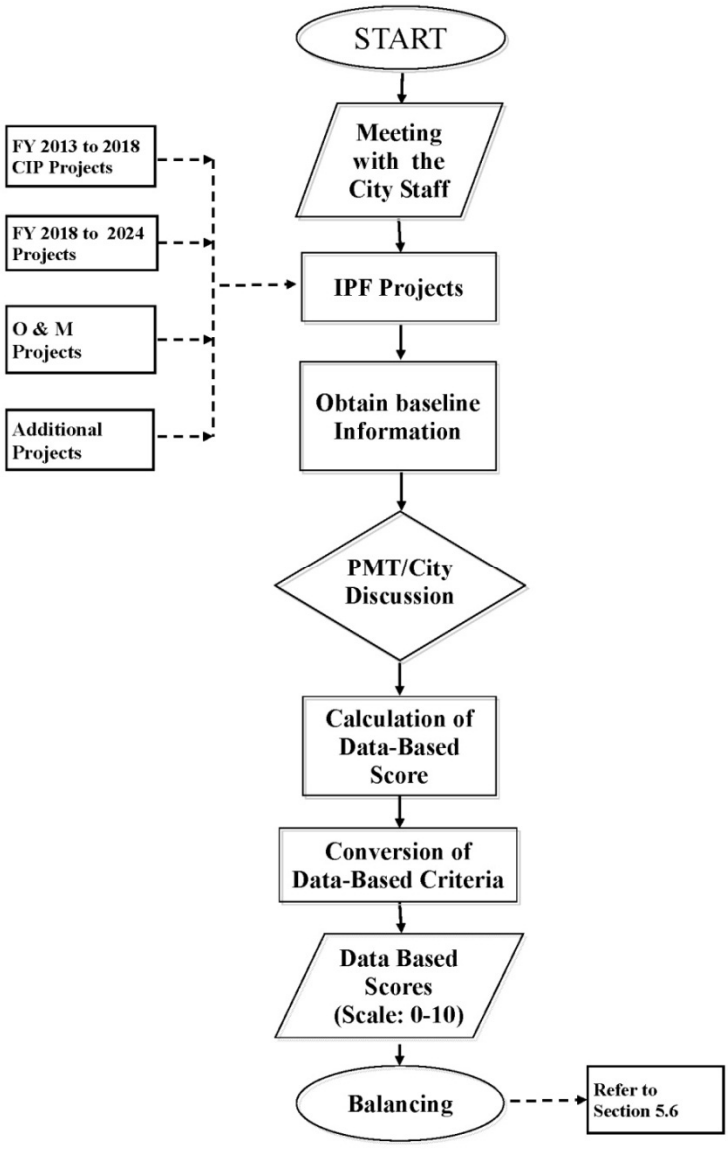


Figure 5.2. IPF Scoring Flow Chart

The scoring process is described below.

1. Meet with Baltimore City staff to obtain a comprehensive list of "IPF Projects" as listed below:
    a. Projects in the City's six Fiscal Year ("FY") CIP, from FY13 through FY18.

   b. Projects beyond the City's FY13 CIP, extending beyond 2018.
   c. Annual recurrent capital and O&M projects.
   d. Additional projects generated from interviews and previous reports or studies.

2. Obtain project baseline information for the IPF Projects (project name, project identification number; description, rationale and justification for the project; project type [e.g., water facility, water utility, wastewater facility, wastewater utility, surface water facility, surface water utility]; cost by fiscal year; and source(s) of available information on the project [e.g., available background data]).
3. Conduct IPF team discussions on each of the 21 evaluation criteria (shown in Table 5.3) to obtain all scale-based raw scores and to obtain available information for data-based score calculations. Appendix B contains details of the scale-based scoring (13 criteria) and the data-based scoring (8 criteria).
4. Perform calculations to obtain data-based raw scores for the eight data-based scoring criteria, with the exception of the capital cost criteria, which was obtained from the City's CIP data in the DPW Fiscal Office database.
5. Convert data-based raw scores to 0 to 10 scale scores (see Appendix B for details of the data conversion process).

As indicated above, two distinct types of scoring were collected:

- Scale-based scores representing a scale from 0 to 10 with 0 being the least favorable and 10 being the most favorable.
- Data-based scores comprising actual data from each project.

The type of scoring applicable to each of the 21 evaluation criteria is shown in Table 5.3.

Table 5.3. Scoring Type for Each Evaluation Criteria

Category and Evaluation Criteria Name	Type of Scoring	Units of Measure
Environmental		
Pollutant Loading to Receiving Waters – Pathogens	Data-Based	# of organisms/year reduced
Pollutant Loading to Receiving Waters – Phosphorus	Data-Based	Lbs/year removed
Pollutant Loading to Receiving Waters – Nitrogen	Data-Based	Lbs/year removed
Pollutant Loading to Receiving Waters – Sediment	Data-Based	Lbs/year removed
Pollutant Loading to Receiving Waters – Trash	Data-Based	Lbs/year removed
Regulatory	Scale-Based	N/A
Habitat Preservation and Restorations	Data-Based	Square feet
Drinking Water Conservation and Control	Scale-Based	N/A
Social		
Health and Safety	Scale-Based	N/A
Recreational Access	Scale-Based	N/A
Urban Tree Canopy	Scale-Based	N/A
Customer Satisfaction	Scale-Based	N/A
Drinking Water Quality	Scale-Based	N/A
Lower Income or Blighted Areas	Scale-Based	N/A
Economic		
Alternative Funding	Scale-Based	N/A
Annual O&M Costs	Scale-Based	N/A
Job Stimulus	Data-Based	Number of jobs created
Capital Costs	Data-Based	Dollars expended
Project Delivery		
Service Life/Condition	Scale-Based	N/A
Project Delay	Scale-Based	N/A
Collaboration	Scale-Based	N/A

Scoring plans were created to facilitate consistency in scoring both for the initial project scoring conducted as part of this IPF as well as for future project scoring required for IPF updates and refinements. The project scoring plans for the scale-based and data-based raw project scoring are described in Subsection 5.6.1 and Subsection 5.8.2, respectively.

5.6.1 Scale-Based Project Scoring Plans

Thirteen of the 21 evaluation criteria were scored on a 0 to 10 scale-based on the knowledge and judgment of City and PMT staff. Score definitions for each of the scale-based criteria are provided in Appendix B. The tables in Appendix B present the color coded criteria and their associated scoring plans.

Scale-based scoring was accomplished via team meetings with Bureau staff to obtain specific project information that allowed the interviewing team to determine how the project should be scored against the criteria using the established scoring plan definitions. Projects were discussed one project at a time and one criterion at a time to determine each score.

5.6.2 Data-Based Project Scoring Plans

The remaining eight of the 21 evaluation criteria reflected quantifiable benefits. These data-based criteria all fall within the environmental and economic categories. Table 5.4 provides the data-based criteria names and the basis for calculating their raw values.

Table 5.4. Calculation Methods for Data-Based Criteria

Category and Evaluation Criteria Name	Water	Wastewater	Surface Water
Environmental			
Pollutant Loading to Receiving Waters – Pathogens	N/A	Collection system hydraulic model	N/A
Pollutant Loading to Receiving Waters – Phosphorus	N/A	Collection system hydraulic model	BMP effectiveness ratio calculation (Appendix C)
Pollutant Loading to Receiving Waters – Nitrogen	N/A	Collection system hydraulic model	MAST Model
Pollutant Loading to Receiving Waters – Sediment	N/A	Collection system hydraulic model	MAST Model
Pollutant Loading to Receiving Waters – Trash	N/A	N/A	USC research
Habitat Preservation and Restorations	N/A	Linear feet of stream restoration times buffer width	Linear feet of stream restoration times buffer width
Economic			
Job Stimulus	Implan Model	Implan Model	Implan Model
Capital Costs	Dollars expended	Dollars expended	Dollars expended

Environmental Criteria. Six environmental criteria are project data driven, of which five are scored based on estimated annual reductions of pollutant loadings. Pollutant reduction criteria include human pathogens, phosphorus, nitrogen, sediments, and trash. Benefits are calculated based on annual number of organisms reduced per year for pathogens and pounds of pollutant

removed per year for the other contaminants. The sixth data-driven criterion is scored based on the amount of habitat area preserved or restored.

Economic Criteria. The remaining two data-based scoring criteria are Job Stimulus and Capital Cost. Job stimulus is defined as the number of direct or indirect (support) jobs created or retained as the result of a project including both construction and long-term employment. Capital costs are the actual capital budget for the lifetime of the project.

5.6.3 Converting Data-Based Criteria to 0 to 10 Scale Scores

0 through 10 scores for each project were assigned based on how the data associated with an individual project related to the results for the entire set of 153 projects mapped to a linear scale. Extremely high and low values were considered outliers and not considered in setting score thresholds. All other scores were distributed along a linear scale. The score thresholds were set to have even intervals such that the highest non-outlying score was a half interval above a score of a 10.

More detail on data-based scoring including the linear scoring thresholds and calculations is provided in Appendix B.

5.7 Project Type Score Balancing

The different nature of wastewater, surface water and drinking water projects means that it is not feasible for all project types to score against the same criteria (as shown in Table 5.5 and Appendix B). For example, many wastewater and stormwater projects are evaluated on their reduction of pollutant loading to receiving water bodies. Drinking water projects, however, generate no improvements to receiving water bodies, but instead confer other environmental and social benefits, namely the provision of potable water for household consumption.

Each project type has the opportunity to score equally on Economic and Project Delivery criteria, but not on Environmental and Social criteria as shown in Table 5.5. For the IPF process to effectively compare diverse project types, all projects must have the opportunity to achieve the same maximum score.

Table 5.5. Unbalanced Project Scoring Opportunities

QBL Category	#	Criteria	Storm Water Facilities	Storm Water Utilities	Water Facilities	Water Utility	Wastewater Facilities	Wastewater Utilities
Environmental	1	Pathogens Removal	0	0	0	0	10	10
	2	Phosphorus Removal	10	10	0	0	10	10
	3	Nitrogen Removal	10	10	0	0	10	10
	4	Sediment Removal	10	10	0	0	10	10
	5	Trash Removal	10	10	0	0	0	0
	6	Regulatory driven projects	10	10	10	0	10	10
	7	Habitat and ecosystems:	10	10	0	0	10	0
	8	Drinking Water Conservation	0	0	10	10	0	0
		Totals	60	60	20	10	60	50
Social	9	Health and Safety	10	10	10	10	10	10
	10	Recreational access	10	10	10	0	10	10
	11	Chesapeake Bay Urban Tree	10	10	10	0	10	10
	12	Customer satisfaction	10	10	10	10	10	10
	13	Drinking Water Quality - Raw	0	0	10	10	0	0
	14	Lower income/blight	10	10	10	10	10	10
		Totals	50	50	60	40	50	50
Economic	15	Alternative Funding	10	10	10	10	10	10
	16	Operate and Maintain	10	10	10	10	10	10
	17	Job stimulus	10	10	10	10	10	10
	18	Capital Costs	10	10	10	10	10	10
		Totals	40	40	40	40	40	40
Project Implementation	19	Service Life / Condition - Does	10	10	10	10	10	10
	20	Impact of Project Delay - What	10	10	10	10	10	10
	21	Collaboration with community	10	10	10	10	10	10
		Totals	30	30	30	30	30	30
Maximum Score for each Project Type			**180**	**180**	**150**	**120**	**180**	**170**

The City considered two methods for balancing these different maximum project scoring opportunities during development of the IPF approach:

- Develop the same number of criteria for each type of project. The downside of this method is that the resulting list of criteria could become exceptionally long, and evaluation criteria may be artificially imposed rather than genuinely chosen by stakeholders.
- Perform mathematical score balancing via appropriate balancing score multipliers. Mathematical balancing results in the use of the desired criteria with equivalent scoring opportunities for each project type.

Figure 5.3 shows how the total maximum scoring opportunities were distributed across each of the project types prior to balancing.

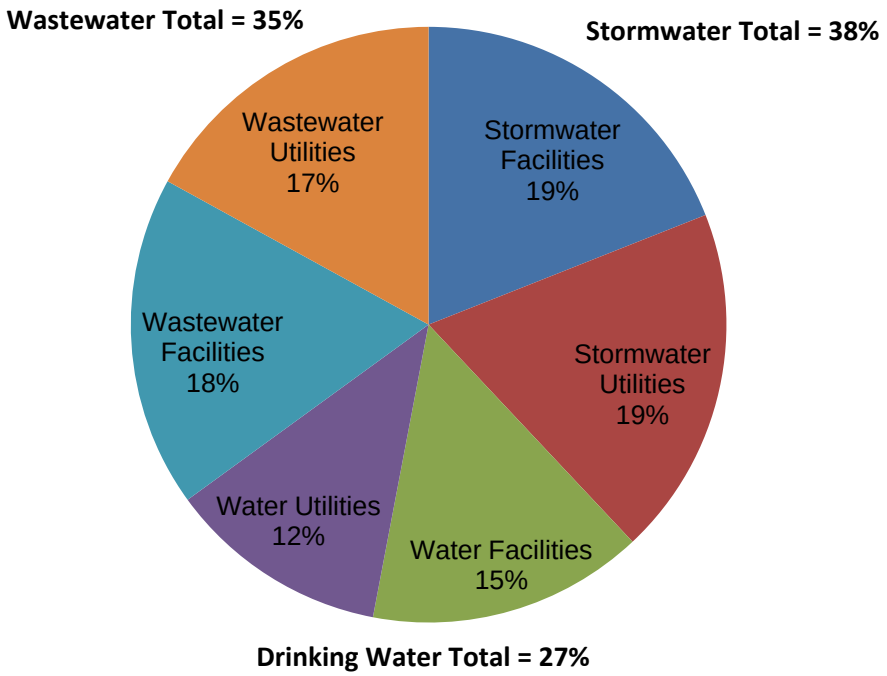


Figure 5.3. Maximum Scoring Opportunities by Project Type

The maximum possible project scores were mathematically balanced as described below and illustrated in Figure 5.4.

Figure 5.4. Score Balancing for Project Types

The maximum possible scores are balanced for each project type within the Environmental and Social categories. This is necessary because the different project types do not all have the opportunity to score against each of the criteria within the Environmental and Social categories (see Appendix C). Note that additional balancing was not required for the Economic or Project Delivery evaluation categories because every project type can score equally against the criteria.

Figure 5.4 is a visual representation of how this maximum possible score balancing is achieved. To balance the maximum possible scores for each project type, a multiplier is applied so that maximum possible score for each project type is adjusted upward as necessary so that all project types have the same maximum possible score.

For example, in the Environmental category, the stormwater utilities, stormwater facilities and wastewater facilities projects have the maximum possible score of 60 points based on the number of criteria they could score against. Wastewater utilities, drinking water utilities and drinking water facilities could only score a maximum of 50, 10 and 20 points, respectively. So all wastewater utilities projects received a multiplier of 60/50, drinking water utilities a multiplier of 60/10 and drinking water facilities project received a multiplier of 60/20. In this way, once balanced, the potential maximum score every project in the environmental category could receive was 60 points.

Figure 5.5 shows how the final maximum possible balanced scores were distributed across the project types.

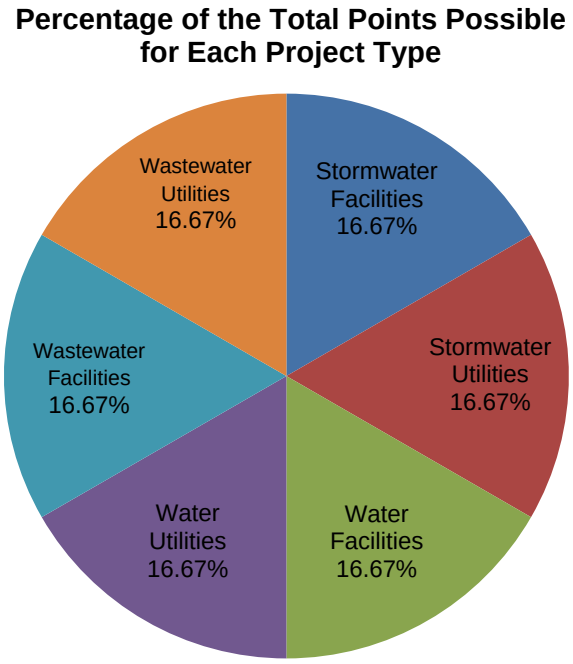


Figure 5.5. Balanced Maximum Possible Scoring Opportunity for Each Project Type

5.8 Importance Weighting

The 21 evaluation criteria selected by the City for the IPF were decided upon after review of many possible evaluation criteria. These 21 were identified as most important by Bureau staff from among a much larger list of possible criteria. Within this list of 21, each criterion has a different level of importance. This variation in relative importance is captured in the use of importance weights applied to each of the 21 criteria in the IPF prioritization model. The total project score is then calculated by multiplying the balanced 0 to 10 score for each criterion by its respective importance weight and summing these 21 products together.

Importance weights for all evaluation criteria were developed using an iterative process with City staff. First, staff individually ranked the criteria in order of importance to them based on their own judgment. Then staff performed a pair-wise comparison during which City staff compared two evaluation criteria at a time to each other in terms of relative importance. For example, City staff indicated whether the 'Sediment Removal' evaluation criteria or the 'Nitrogen Removal' evaluation criteria was more important and by how much. Each individual answer was recorded by decision-analysis software application and compiled. By responding to a series of comparisons across all 21 evaluation criteria, the application generated an output of the mathematical interpretation of the pairwise selections City staff provided. City staff was able to iterate on this process until there was agreement on the relative importance of all criteria to each other. Figure 5.6 shows an example of the pairwise comparison process. The top schematic shows a pairwise comparison between two of the benefit categories and the bottom schematic shows a pairwise comparison between criteria within the Environmental category.

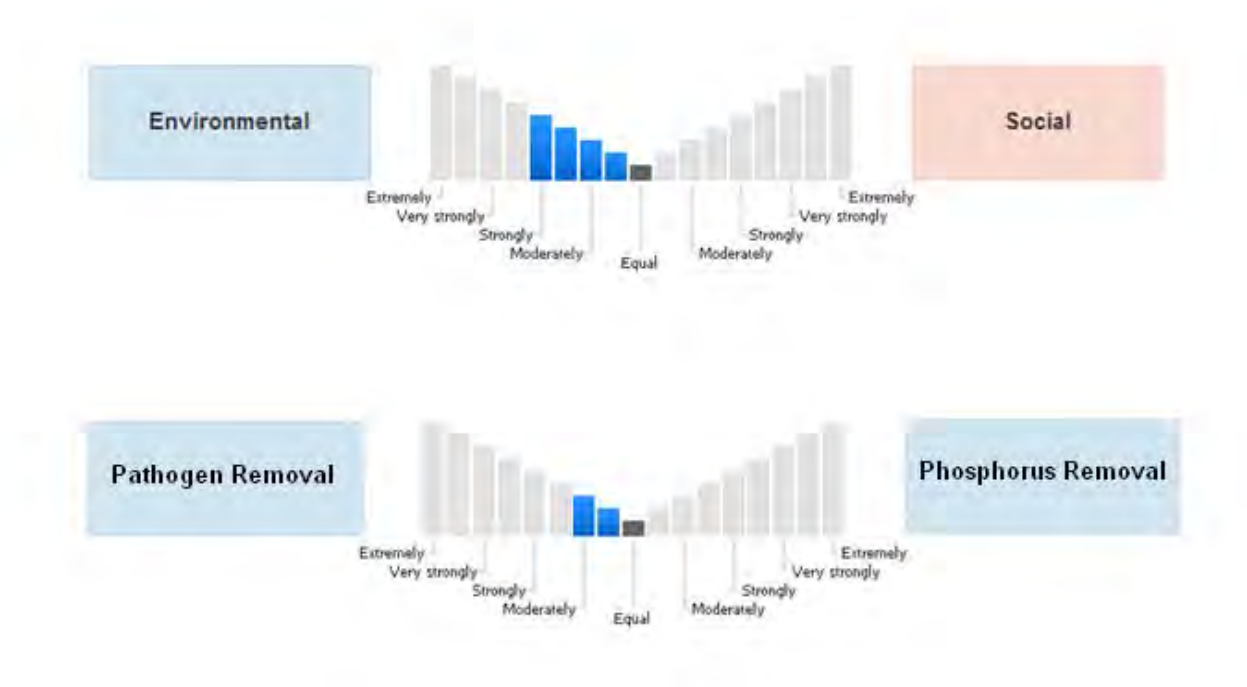


Figure 5.6. Pairwise Importance Comparison Example

Figure 5.7 shows the importance weight output used in the IPF process. The evaluation criteria are listed in decreasing order of priority. The length of the bars in the schematic indicate the relative importance weighting of the draft importance weights.

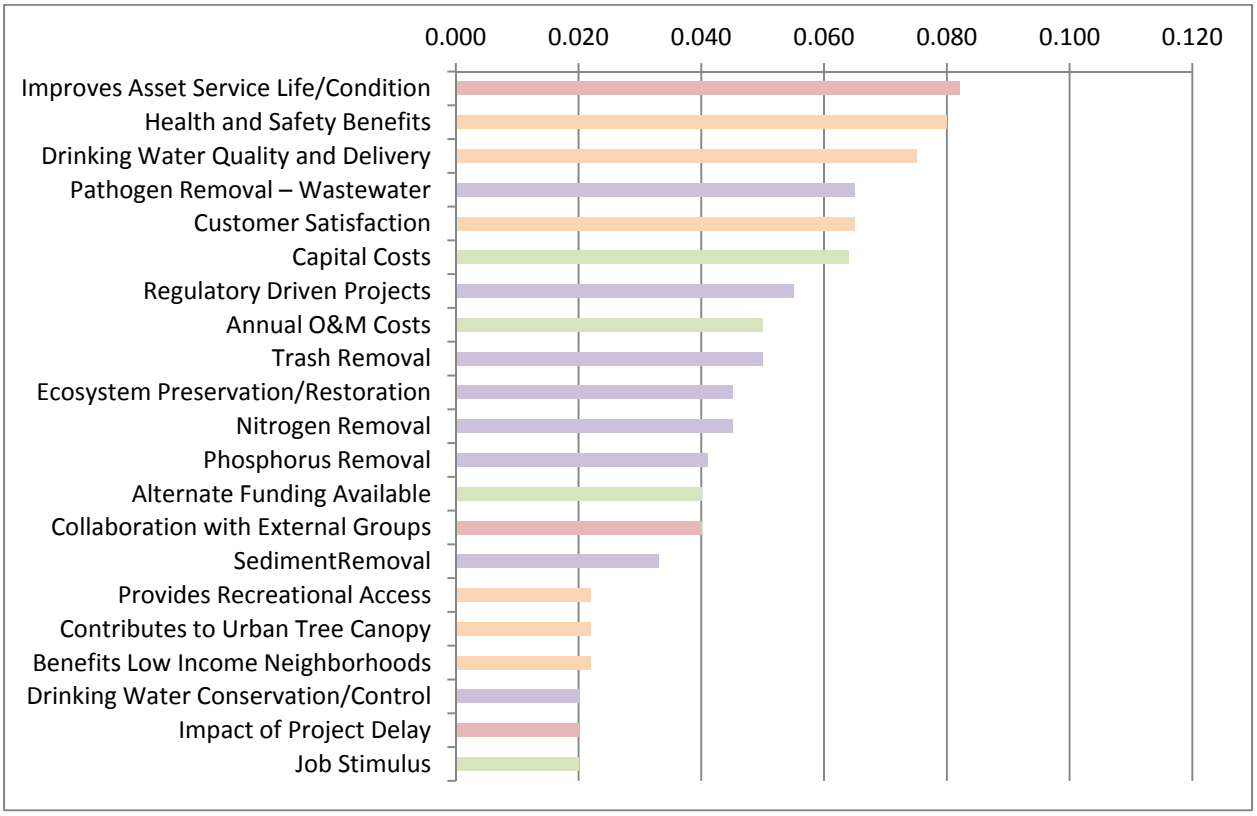


Figure 5.7. Importance Weighting Results

Importance weights are a critical part of a prioritization process. Modifying importance weights has the potential to result in a different prioritized project list and may impact project scheduling. Identifying an appropriate set of importance weighting factors is a critical aspect of prioritization efforts. It is common and expected that over time the importance weighting factors will be reviewed, revisited and adjusted as needed.

6 SCENARIO DEVELOPMENT

6.1 Scenario Descriptions

Three different infrastructure implementation scenarios are conceptualized as part of the City's IPF. Each scenario consists of a prioritization scheme and the implementation plan that results from applying the prioritization scheme to the project list. The prioritization schemes are constructed based on different potential internal and external constraints, as described below.

- **Scenario 1**. This is known as the "Baltimore IPF" scenario. It is "unconstrained" because all project types (i.e., stormwater, wastewater, and water) are included. The IPF projects are evaluated across the full suite of the QBL evaluation criteria. This scenario reflects the City's preferences as reflected by the importance weighting of the evaluation criteria (further explained in Section 6.2). This scenario also includes sub-scenarios with varying financial and project schedule assumptions. For example, in some sub-scenarios the expected annual recurrent capital and O&M cost differs and in some sub-scenarios the capital projects are allowed to extend beyond the study period.
- **Scenario 2**. This is known as the "EPA IPF" scenario. This scenario follows the EPA guidance that recommends inclusion of wastewater and stormwater projects.[17] Water projects are excluded from this scenario. It is termed "constrained" to reflect this exclusion. Scenario 2 is the same as Scenario 1 except that all water projects have been removed.
- **Scenario 3**. This scenario is the "Regulatory" scenario, which is essentially the current situation (i.e., the status quo). This scenario functions as a baseline scenario as it is modeled to reflect the current conditions where regulatory considerations substantially drive project prioritization to the exclusion of other considerations.

Figure 6.1 illustrates the three scenarios.

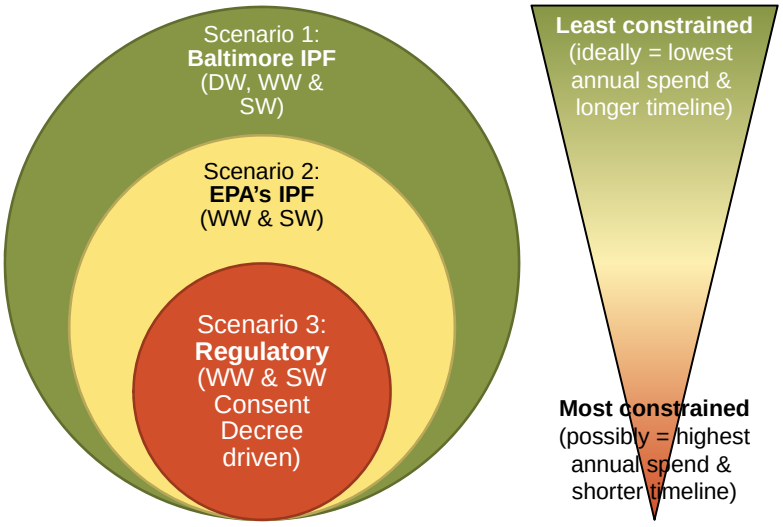


Figure 6.1. Baltimore IPF Scenario Constraint Illustration

[17] U. S. Environmental Protection Agency, *Achieving Water Quality Through Municipal Stormwater and Wastewater Plans,* October 27, 2011. Available at http://cfpub.epa.gov/npdes/integratedplans.cfm.

6.2 Weighted Total Score Calculation

Each project balanced score was multiplied by the corresponding importance weight for that evaluation criterion. The sum of this series of multiplications for each project is the total weighted score for that project. This is illustrated in Figure 6.2.

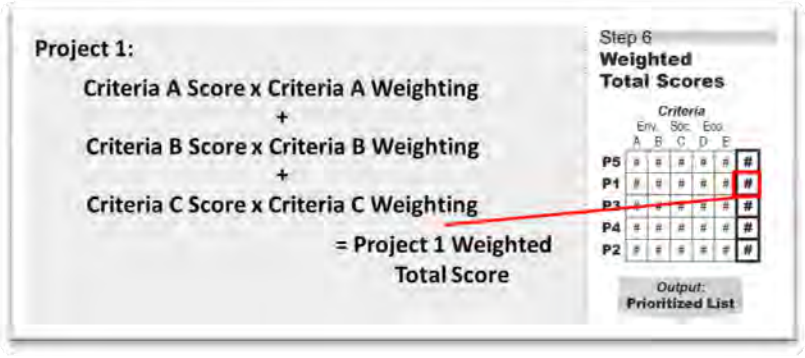


Figure 6.2. Example Weighted Total Score Calculation

Importance weights are integral to the three identified scenarios. For Scenarios 1 and 2, the importance weights are developed based on City preferences regarding which criteria are important, more important and most important. The importance weights being utilized for Scenarios 1 and 2 are those shown in Figure 5.7.

In Scenario 3, however, the importance weights of the regulatory-related evaluation criteria are higher than in Scenarios 1 and 2. Scenario 3 represents the conditions where regulatory considerations are the primary, but not sole, drivers for which projects get prioritized. Scenario 1 represents the condition where regulatory considerations are still important yet balanced with needs and priorities. Scenario 2 is similar to Scenario 1 except that in Scenario 2, only wastewater and stormwater projects are considered.

Figure 6.3 presents importance weightings for Scenario 1, Baltimore IPF, and for Scenario 2, EPA IPF. Figure 6.4 presents importance weightings for Scenario 3, Regulatory.

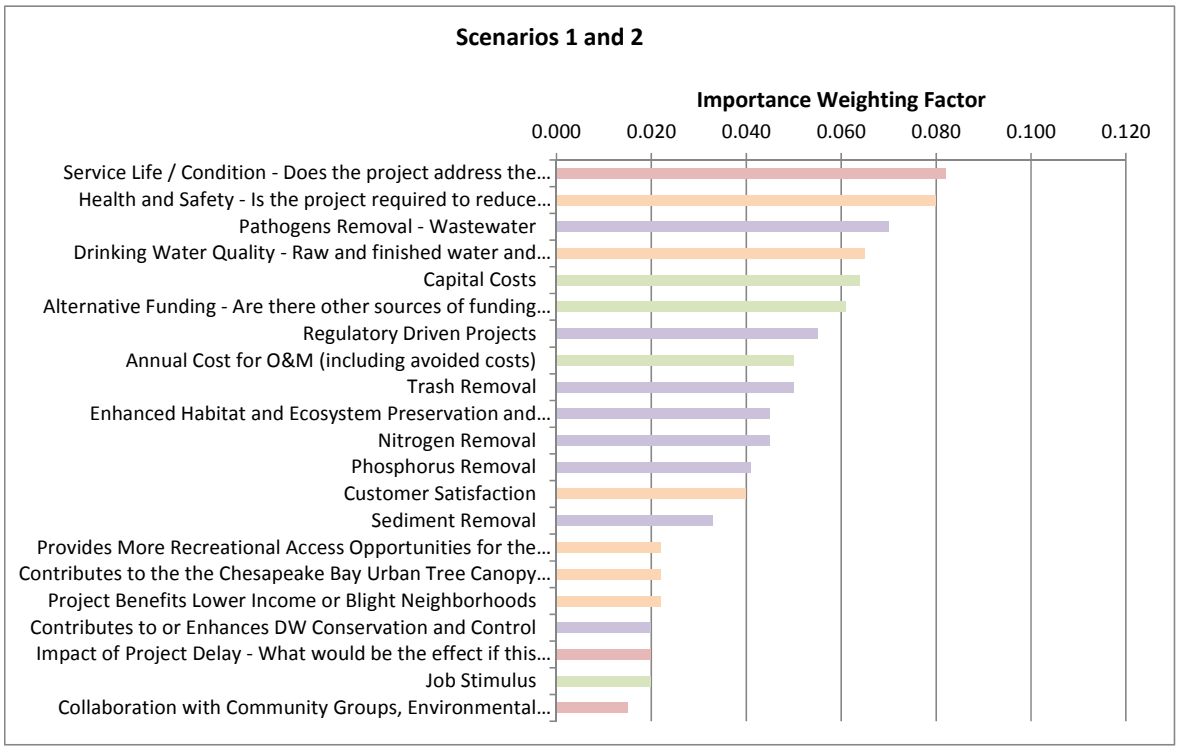


Figure 6.3. IPF Scenarios 1 and 2 Importance Weights

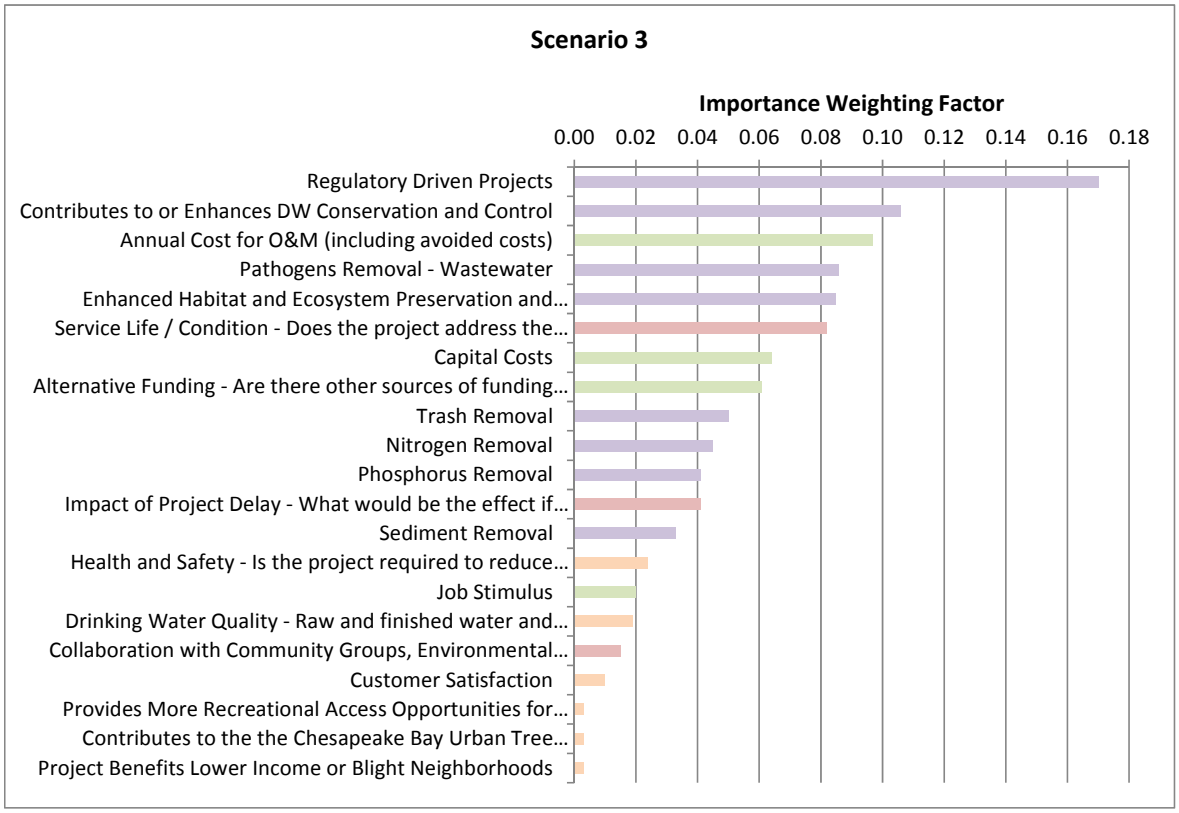


Figure 6.4. IPF Scenario 3 Importance Weights

6.3 IPF Prioritized Project List

Once the importance weightings are applied, projects are ordered from highest to lowest weighted total score. The prioritized project list identifies which projects are expected to have the most overall benefit to the City, its residents, and the local and regional environment.

6.4 IPF Project Scheduling

The prioritized project list is useful for the City to gauge which projects are expected to bring the most benefit, but it does not factor in project cost, project dependencies, constructability issues, or other scheduling considerations. If the City were to schedule projects sequentially from the prioritized list it would disproportionately favor large capital projects in early years instead of a balanced portfolio. Large capital projects tend to have greater overall impacts than smaller ones, but also greater overall costs. Multiple smaller capital projects may have the same combined cost and a greater combined benefit than one large project. For example, the project with the highest overall weighted balanced score of 6.14 has a total capital cost of only $150,000. The smaller project provides considerable benefit at a much lower cost.

Therefore, the City is also utilizing a project scheduling model that factors in both project and financial considerations to optimize its infrastructure investments. The project scheduling model takes financial and scheduling constraints as inputs and optimizes project scheduling to provide the greatest QBL benefit over a 20-year planning period. The model optimizes project scheduling so that the overall benefit (the sum of the balanced, prioritized criteria scores) is maximized over the planning period while staying within model constraints. The constraints include financial availability, fixed project dates and project dependencies (i.e., whether a project must be completed before another project can be initiated).

The IPF project scheduling model is used to create the project schedule for Scenario 1.

6.4.1 Scheduling Model Approach

The following are a list of key constraints that any schedule the model produces must follow. The key model constraints include:

- Projects with constrained start and end dates;
- Project predecessor/successor relationships (to be included in an updated IPF); and
- Total anticipated funding available on a yearly basis.

The projects with constrained start and end dates include projects that are already underway, and projects that are considered “mission critical” for the City projects. Projects underway are set in the model to follow their planned completion schedule by default. Mission critical projects are constrained to complete within the 20-year planning period or earlier. The model has the ability to defer any other projects beyond the study period if the anticipated funding is not adequate to fund all projects.

Table A.3 in Appendix A shows projects listed as currently underway. Table A.4 in Appendix A shows projects the City identified as mission critical for utility operation. The list of projects considered “mission critical” is currently under review by the City and will be revised as needed as part of future IPF updates.

The model has the ability to enforce project relationships such as predecessor and successor projects or concurrent projects (e.g. cross-asset optimization). This aspect of the model was not included in this draft report but is expected to be added in future iterations of the City's IPF.

The final key constraint is the expected funding available in each fiscal year. If there were no funding constraints, the model would choose all projects to be funded in the first year, an output that is unrealistic both on financial and constructability grounds. The City has created three potential financial sub-scenarios (Scenarios 1A, 1B and 1C), which are described in Section 7. The funding constraints, as well as the annual cost per project, reflect only costs borne by the City, not costs borne by Baltimore County or covered by grant funds.

Figure 6.5 illustrates the modeling constraints in a simplified manner. All constrained project spending is fixed; other project spending may be allocated up to the annual available funding constraint in each year.

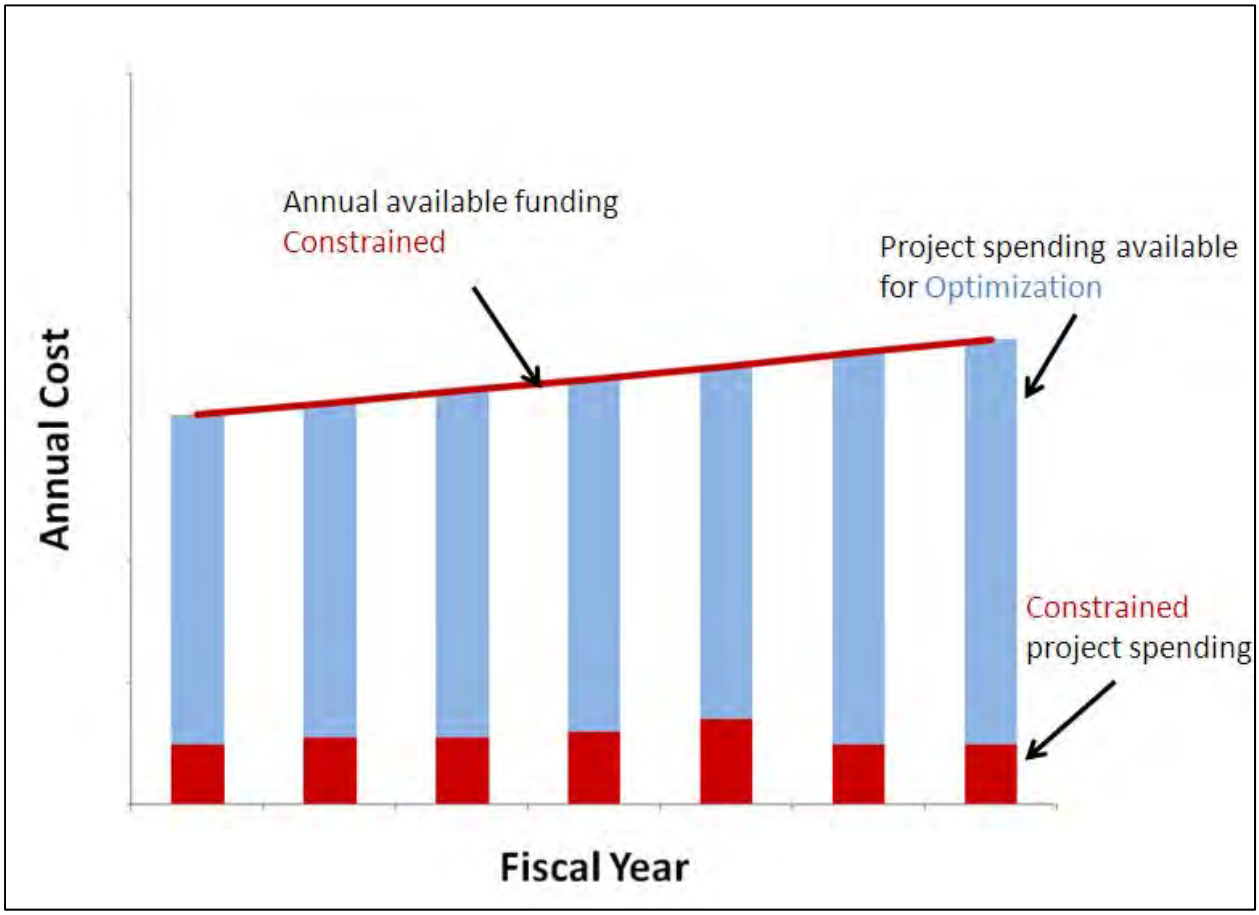


Figure 6.5. Scheduling Model Constraint Conceptualization

6.4.2 Financial Assumptions

The model makes several important financial assumptions. The time value of money is factored into the analysis by escalating future costs with a 3 percent inflation rate. Baltimore City uses a 3 percent inflation rate for all net present value (NPV) analysis. The capital cost of any project

that moves later from the base year of FY13 is escalated by this compounded 3 percent inflation rate.

While the annual spend patterns for projects are complex, it is the City's policy to average the total capital cost of a project over the project duration for planning purposes. Therefore, the total project cost of each capital project was spread evenly over the estimated project duration.

The project scheduling optimization model specifies an annual spending limit constraint as an input parameter. The model incorporates the time value of money into the annual spending limit; the funding ceiling is multiplied by a compounded inflation factor in each subsequent year.

6.4.3 Project Assumptions

The model uses the CIP project list from FY13. Updates to the CIP list have been developed by the City as of December 2012; however, changes in the project list will not be reflected until the next iteration of the IPF process as this draft report was well under development by the time the updated CIP was available.

The City recognized that it will undertake infrastructure capital and O&M activities in addition to its portfolio of CIP projects. The CIP list only covers six years and does not consider all long-term capital and O&M utility infrastructure needs of the City. Therefore, a list of 27 capital and O&M projects that the City is currently planning, at a total cost of approximately $250 million (in $FY13 dollars) has been identified (see Table A.5 in Appendix A). The City's IPF incorporates the assumption that the annual cost of these capital and O&M projects is representative of continuing capital and O&M projects in the future. Therefore, the same dollar amount of capital and O&M projects (adjusted for inflation) has been included in the IPF for FY19 through the end of the planning period and is referred to in this report as "recurrent capital and O&M expenditures".

Each unconstrained project is allowed to start in any fiscal year from FY13 until the end of the planning period. If the model determines that sufficient funding is not available, some projects may be unfunded within the planning period. The model is able to select any combination of projects and project sequencing that stays within the constraints. However, not all project schedules are equally beneficial to the City, its residents, and the environment. Therefore, the model used an optimization algorithm to choose the most beneficial schedule as the output.

If a project is scheduled for FY13, it receives its full QBL benefit score as described in Section 5. If a project is selected in a later year, it still receives a benefit score, but it is depreciated by a benefit discount rate. Applying a benefit discount rate incentivizes scheduling projects in early years. The National Center for Environmental Economics ("NCEE") recommends that any cost-benefit analysis should apply the same discount rate to benefits as to costs.[18] As noted in Subsection 6.4.2, the City uses an assumed 3 percent annual inflation rate as a discount rate for costs in financial analyses. The IPF analysis used the same 3 percent as the benefit discount rate.

Benefit discounting encourages selecting projects early in the planning period. Since the same percentage discount is applied to any project pushed into future years, projects that scored a higher benefit score lower when shifted in future years than projects with a low benefit score. This results in projects with high benefit scores and low cost being more heavily favored for early year scheduling.

[18] National Center for Environmental Economics, *Guidelines for Preparing Economic Analyses,* December 2010. Available online at http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Guidelines.html.

6.4.4 Model Scenarios

The City has developed several alternatives with different input assumptions to compare the resulting model outputs. The Regulatory Scenario consists of all projects as currently scheduled. The model assumption for this scenario is that under the status quo the Consent Decree projects will be complete in FY23. The project scheduling model was not used in the Status Quo case as all project start and end dates are set.

Scenario 1A, Scenario 1B, and Scenario 1C were generated in the project scheduling model. While all considered the same portfolio of projects, they differed in the annual available funding limit, whether non-critical projects are able to be deferred beyond the planning period, and the annual dollar amount reserved for recurrent capital and O&M projects. Table 6.1 below summarizes the different input values to the three sub-scenarios.

In Scenario 1A, all capital projects must be completed within the 20-year planning period and recurrent capital and O&M projects are expected to cost the City $250 million a year in FY13 dollars. The funding cap was set at $320 million in FY13 dollars, the lowest possible level to allow all projects to be completed and all model constraints to be satisfied.

Scenarios 1B and 1C reflect conditions with lower annual available funding limits than Scenario 1A. To reduce annual spending, recurrent capital and O&M expenditures must be reduced, capital projects must be deferred beyond the study period, or both.

Scenario 1B caps annual spending at $250 million in FY13 dollars while reducing annual recurrent capital O&M expenditures to $210 million in FY13 dollars. Capital projects may be deferred beyond the study period in this scenario.

Scenario 1C caps annual spending at $250 million in FY13 dollars while reducing annual recurrent capital O&M expenditures to $170 million in FY13 dollars. Capital projects may not be deferred beyond the study period in this scenario.

A comparison of model inputs in the Regulatory Scenario, Scenario 1A, Scenario 1B and Scenario 1C is shown in Table 6.1. Comparison of Model Inputs.

Table 6.1. Comparison of Model Inputs

Scenario	Annual Spending Limit	Annual Recurrent Project Expenditures (FY19 and beyond)	Unconstrained Projects May Be Deferred
Regulatory	N/A	$250 million	No
Scenario 1A	$320 million	$250 million	No
Scenario 1B	$250 million	$210 million	Yes
Scenario 1C	$250 million	$170 million	No

All dollar amounts listed in FY13 dollars

6.4.5 Project Selection Model Results

This section includes the project scheduling model results for each of Scenario 1A, Scenario 1B, and Scenario 1C. Key model outputs, including the average expenditure per year in FY13

dollars, the number of capital projects deferred past the planning period, and the year of last Consent Decree project completion, are shown in Table 6.2.

Table 6.2. Comparison of Model Outputs

Scenario	Average Spend Per Year	Number of Capital Projects Deferred Past FY32	Consent Decree Completion
Regulatory	$275 million	None	FY23
Scenario 1A	$283 million	None	FY30
Scenario 1B	$229 million	18	FY32
Scenario 1C	$225 million	None	FY28

All dollar amounts listed in FY13 dollars

Scenario 1B resulted in 18 capital projects being deferred beyond end of the planning period in FY32. These projects are shown in Table 6.3. It is important to note that these are draft analysis results pending review from other stakeholders and iterations before moving forward in finalizing the model results. The list of projects considered "mission critical" is currently under review by the City and will be revised as needed as part of future IPF updates.

Table 6.3. Scenario 1B Resultant Deferred Project List

Type	CIP #	Project Name
SWU	520-102	Small Storm Drain and Inlet Repair
WU	557-099	GIS Support and Improvements
WF	557-070	Watershed Bridge Repair
WF	557-330	Urgent Needs Water Facilities – Annual Improvements
WF	557-312	Montebello WTP 1 & 2 Improvements
WF	557-696	Chlorine Handling Safety Improvements WC-1150
WF	557-709	Finished Water Improvements – Guilford FW Reservoir
WF	557-716	UV disinfection – Druid Lake FW Reservoir
WF	557-731	Montebello Water Recycle Program
WF	557-921	Maintenance Bldg. Improvements At Liberty Dam WC 1207
WF	557-928	Ashburton Pump Station Rehabilitation
WF	NEW	Hydropower Study
WF	NEW	Baltimore City Water Bottling – Feasibility Study
WF	NEW	Water Supply Capacity Analysis
WWU	551-569	Urgent Needs Sanitary Design Services
WWF	551-557	Enhanced Nutrient Removal at Back River WWTP, SC-887, SC-882
WWF	551-503	On Call Engineering Services
WWF	NEW	Patapsco WWTP Chrome Contaminated Soil Removal

Projected annual spending by project type for all scenario outputs is shown in the cost histograms below. Annual expenditures are color coded by project type. The dollar amounts shown in the cost histograms are in nominal terms – the bar in FY32 expresses the cost in FY32 dollars while the bar in FY13 is in FY13 dollars. The cost histograms also show the year of last Consent Decree project completion and the average annual cost, converted into real (FY13) dollars.

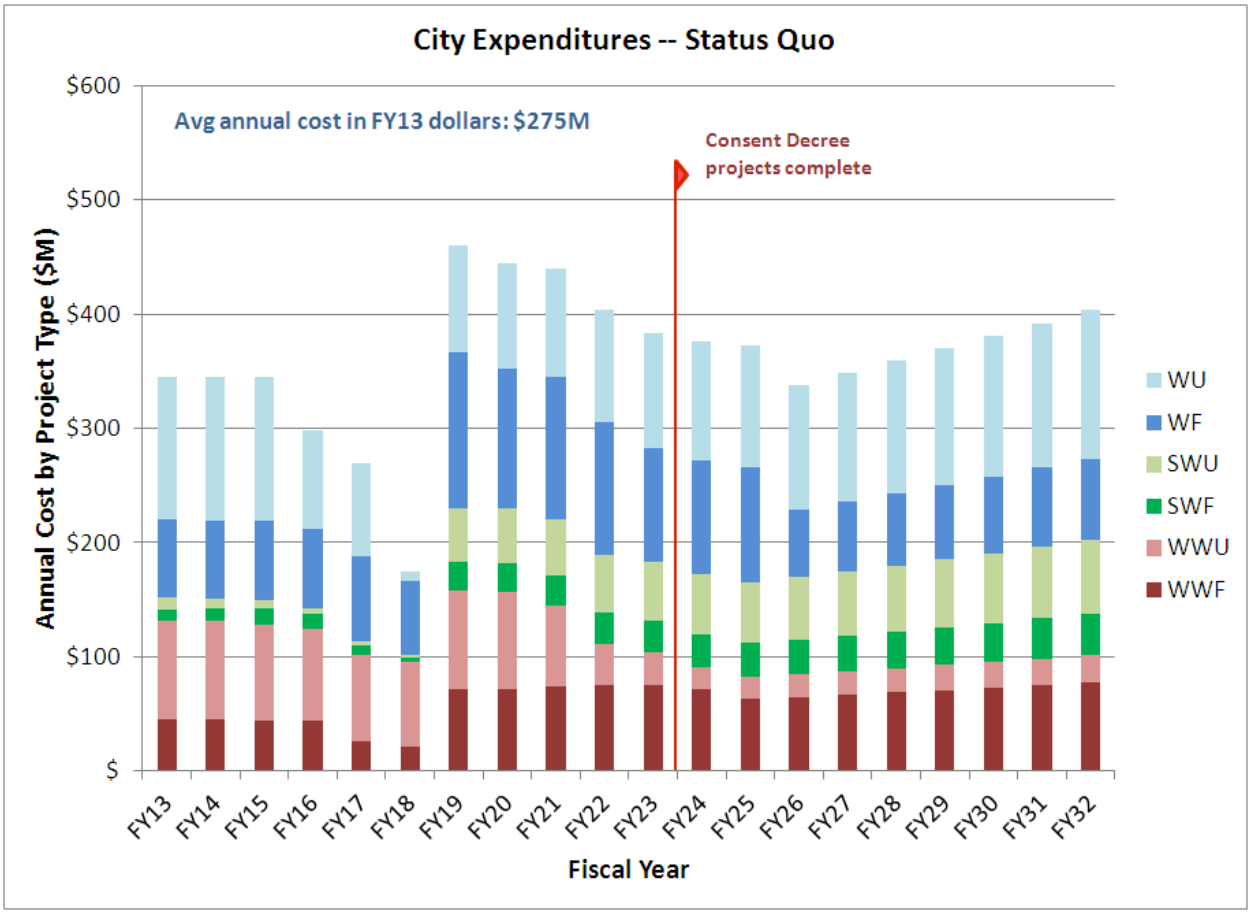


Figure 6.6. Project Annual Spending – Scenario 3, Regulatory (Status Quo)

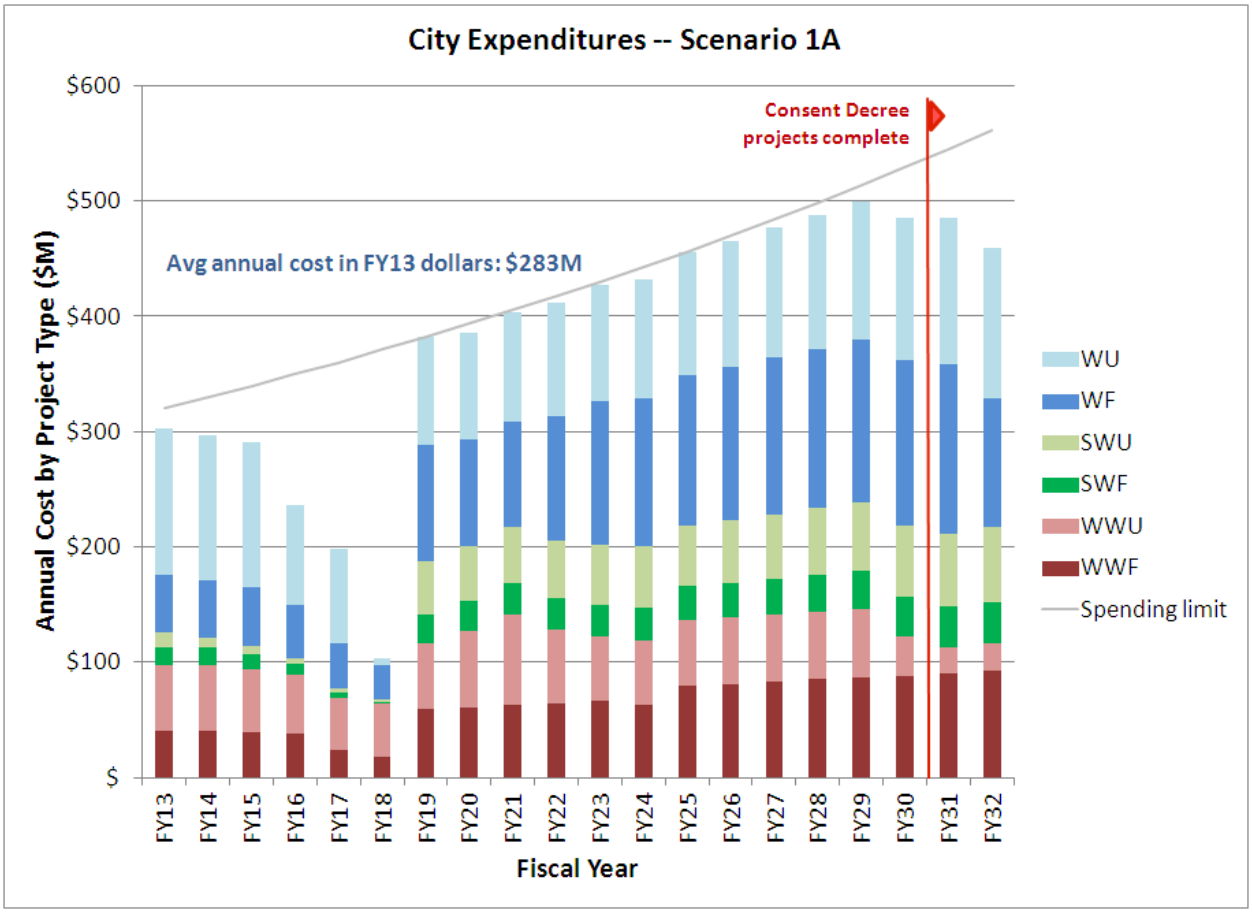


Figure 6.7. Project Annual Spending – Scenario 1A

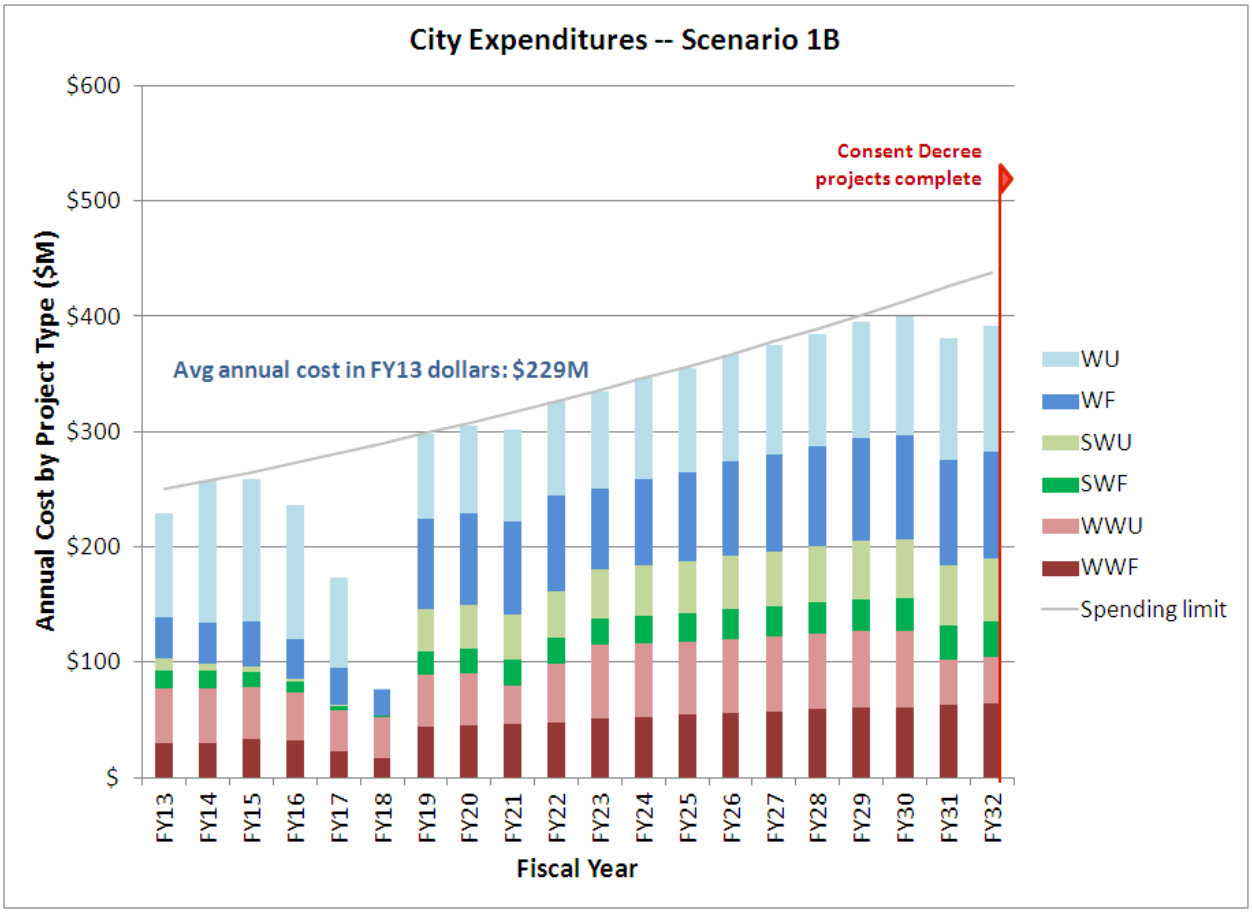


Figure 6.8. Project Annual Spending – Scenario 1B

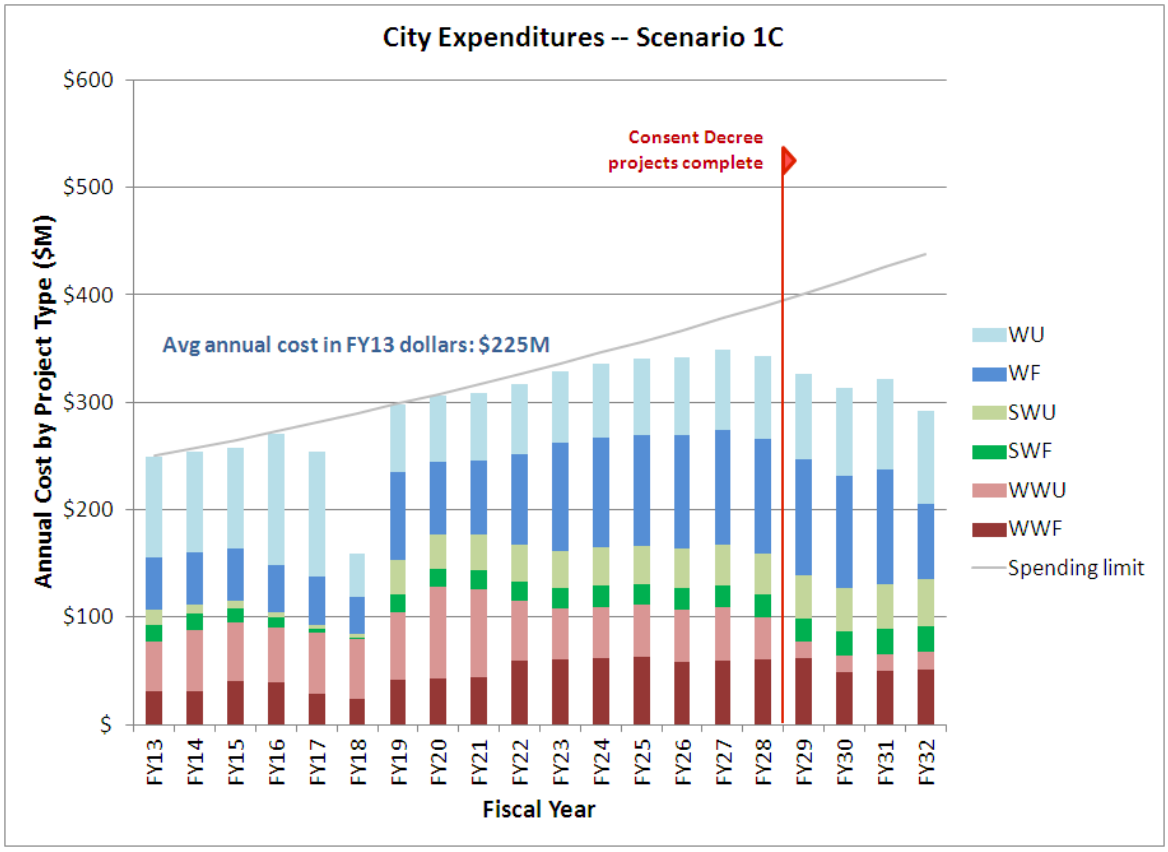


Figure 6.9. Project Annual Spending – Scenario 1C

6.5 Benefits Distribution Analysis

The Benefits Distribution Analysis calculates how the QBL benefits are temporally distributed within the portfolio of projects, specifically, the scenarios and sub-scenarios described in Section 6. While the project scoring described in Section 5 describes the QBL benefits associated with individual projects, Benefits Distribution Analysis allows for an understanding of how the different project scenarios impact the timing of total benefits delivered as a result of completing the projects.

The Benefits Distribution model demonstrates the accrual of QBL benefits of each scenario over time. This benefits accrual compares the differing benefits distribution over time of one project funding scenario to another. It does not compare benefits across projects within each scenario.

6.5.1 Benefits Distribution Analysis Methodology

The Benefits Distribution Analysis methodology uses the project scores to generate a resulting benefits distribution over the planning period.

The methodology includes a process to define how benefit scores are distributed over time. For each of the 21 criteria, the City established a “rule of thumb” that defined how each type of benefit accrues over time. These rules of thumb are based on technical knowledge, industry practices and general knowledge of how benefits would actually be realized. Table 6.4 presents these benefits rules of thumb that were used in the model development.

Table 6.4. Benefits Distribution Model "Rules of Thumb"

QBL Category	Criterion #	Criteria	Sub Criteria and/or Criteria Detail	Rules of Thumb					
				Stormwater Facilities	Stormwater Utilities	Water Facilities	Water Utilities	Wastewater Facilities	Wastewater Utilities
Environmental	1	Pollutant Loading to Receiving Waters	Pathogens Removal - Wastewater	N/A	N/A	N/A	N/A		
	2		Phosphorus Removal	Spread the score evenly over time from project end through the end of the evaluation period		N/A	N/A		
	3		Nitrogen Removal			N/A	N/A		
	4		Sediment Removal			N/A	N/A		
	5		Trash Removal				N/A		N/A
	6	Regulatory	The project has the following regulatory drivers	Total score applied on the year of completion			N/A	Total score applied on the year of completion	
	7	Habitat Preservation and Restoration	Area of ecosystem actively restored/preserved	Spread the score evenly over time from project end through the end of the evaluation period					
	8	Drinking Water Conservation and Control	The project contributes to or enhances the conservation or control of drinking water	N/A	N/A	Spread the score evenly over time from project end through the end of the evaluation period		N/A	N/A
Social	9	Health and Safety	The project reduces current or potential impacts to the following items: - Traffic (6 lanes or more) - Traffic (with no easy alternative detour) - Traffic (with easy alternative detour) - City homes (basement floods, water service) - County customers - City businesses (water service, access to business) - Streams and harbor (quantity and quality) - Other utilities - Hazard to human life, health or property	Spread the score evenly over time from project end through the end of the evaluation period					
	10	Recreational Access	The project provides recreational opportunities for the public in the following manner - Improves community aesthetics - Walking/running - Swimming - Biking - Picnics - Boating - Fishing	Spread the score evenly over time from project end through the end of the evaluation period			N/A	Spread the score evenly over time from project end through the end of the evaluation period	
	11	Urban Tree Canopy	The project contributes to the Chesapeake Bay Urban Tree Canopy Goals to restore 2,010 miles of forest buffers	Spread the score evenly over time from project end through the end of the evaluation period					
	12	Customer Satisfaction	The project reduces the number of complaints or service disruptions	Spread the score evenly over time from project end through the end of the evaluation period					
	13	Drinking Water Quality	The project delivers reductions in the following raw and finished water & delivery attributes to end users: - Microorganisms - Disinfectants - Disinfection Byproducts - Organic Chemicals - Inorganic Chemicals - Lead or copper - Taste, odor, color	N/A	N/A	Spread the score evenly over time from project end through the end of the evaluation period		N/A	N/A
	14	Lower Income or Blighted Neighborhoods	The project benefits low income or blighted neighborhoods	Spread the score evenly over time from project end through the end of the evaluation period					
Economic	15	Alternative Funding	The project has additional funding sources	Spread the score evenly over each year of project capital spend					
	16	Annual O&M Costs	Annual O&M cost, including avoided costs	Spread the score evenly over time from project end through the end of the evaluation period					
	17	Job Stimulus	Jobs created by the project, both construction and long-term	Spread the score evenly over each year of project capital spend					
	18	Capital Costs	Capital Costs	Spread the score evenly over each year of project capital spend					
Project Delivery	19	Service Life / Condition	The project addresses the condition of existing materials/ systems in the following manner	Total score applied on the year of completion					
	20	Project Delay	The effect if this project is deferred at least 1 year This is not to include regulatory impacts or fines, which are accounted for in environmental criteria	Total score applied on the year of completion					
	21	Collaboration	The project has involved engagement with community groups, environmental groups, NGOs	Spread the score evenly over time from project end through the end of the evaluation period					

In general, the rules fall into two categories: benefits that recur over multiple years and benefits that are realized in a one-time application. An example of a recurring benefit is trash removal; if a project had the benefit of removing trash, that benefit would continue year after year. Conversely, a benefit such as achieving a project milestone such as regulatory compliance is realized as a one-time benefit upon project completion.

Though several of the annual benefits could continue for many years, the City elected to limit the maximum annual benefits recurrence to a six year period. This reflects a conservative estimate in the Benefits Distribution Model. In reality, a strong case can be made that many benefits would continue on after six years. This conservative assumption alleviates the need to decrease benefits over time to reflect the impact of aging assets.

The City considered the possibility of prorating benefits over time as natural assets mature. As an example, the benefits associated with the Urban Tree Canopy criterion could be thought of to start small and increase over time as trees grow and mature. The City determined that in such an example, the trees provide immediate and consistent benefit. The level of detail of the Benefits Distribution Model warrants a consistent benefit value for each circumstance. Future iterations of the City's IPF may consider adding this additional depth to the analysis if warranted.

If the benefit is an annual benefit, the total score is divided by the number of years the score was distributed (typically six), and then distributed evenly across those six years. Most annual scores begin the year of project completion, as that is typically when the actual benefits begin to be realized, although some scores begin the year the project is initiated, as appropriate to those criteria. An example of an exception would be the Job Stimulus criterion, where the benefits are realized during construction years, when the construction is creating active employment. The benefits for this criterion end when construction is completed and jobs are no longer active.

The benefit scores are calculated for each Scenario outlined in Section 6. The rules of thumb are applied to each project to obtain a benefit score by criterion per year. The distribution of scores is based on the fiscal years in which projects are initiated, delivered and completed. The benefits scores are not pro-rated to actual start or end dates inside of a particular fiscal year (i.e., a benefit accrues to a project in that year regardless of whether the project starts in January or October of that year), and the calculations do not reflect variances in yearly spending over a project's life. The fiscal year when a project ends is, depending on the rule applied, considered both a year of active project activity and the first year (of the total six) post project benefits.

It is also worth noting that, because the benefits are meant to compare different funding sub-scenarios and not across individual criteria (e.g., Habitat Restoration and Preservation vs. Drinking Water Preservation and Control) or benefit categories (i.e., Environmental, Social, Economic and Ease of Implementation), unbalanced scores (described in Section 5) were used in this analysis.

Benefit scores are totaled within each scenario by fiscal year and graphed across the IPF timeline to produce a benefits distribution.

6.5.2 Benefits Distribution Analysis Example Calculations

In order to represent how the Benefits Distribution Analysis calculations work, a few representative examples are outlined below:

The first example is for an annual benefit criterion, such as Annual O&M Costs. If a project is expected to result in a slight decrease (< 20%) in O&M costs from what would otherwise exist

without the project, and the project was due to be completed in FY14, it would receive a total score of 6. If the project were due to be completed in FY14, the project score would be averaged over a six year time frame (the maximum number of years benefits accrue in the model) from FY15 through FY19. The project would therefore be given a benefits score of 1 for FYs 14, 15, 16, 17, 18 and 19.

Some annual benefits accrue as a project is active and, contrary to the previous case, do not extend beyond the project's end date. Such is the case with Capital Costs. For this example criterion, the total score is divided evenly over each fiscal year of project expenditures. So if a project has a score of 10 in the Capital Costs criterion and is scheduled to begin in FY15 and be completed in FY19, then it would accrue a score 2 (score of 10 divided by 5 funding years) in each of FY 15, 16, 17, 18 and 19.

In the criterion for Project Delay for which the criterion benefits accrue at one point in time, a project is assigned a score of 6.6 where some delay may be acceptable, although there may be cost impacts. If a project were due to be completed in FY13, that project would be assigned a score of 6.6 only in FY13.

6.5.3 Discussion of Benefits Distribution Analysis Results

Figure 6.10 shows the annual benefit score for the Status Quo Scenario, and the three selected IPF Scenarios for comparison. The IPF Scenarios show an earlier realization of benefits than the Status Quo Scenario. This is a preliminary analysis and future IPF efforts will include additional examination of how the movements of individual projects within the portfolios impact the benefits distribution.

It is also important to note that several IPF projects associated with ongoing operations and maintenance have been included in the results, but these projects have not yet been scored in all evaluation criteria categories. After these projects have been fully scored, benefits are expected to increase overall. It is also expected that the shape of the curve would become smoother, as these recurrent capital and O&M projects are scheduled to start in 2019. The City's new UAMD (Utility Asset Management Division) initiative will define and identify these recurrent capital and O&M projects more fully and their associated benefits and costs. As the City's new UAMD takes form, the IPF project information, costs, and benefits will be updated accordingly. It is understood that funding invested in proactive asset management and O&M efforts will have a lag time before benefits start to accrue and be realized. In addition, the proactive UAMD efforts will aim to achieve the benefit of reducing the overall risk of failure in the City's utility infrastructure. Future improvements to the City's IPF may include more robust examination of this risk benefit than the current IPF analysis.

Tables of the Benefits Distribution scores by project and year are included in Appendix E.

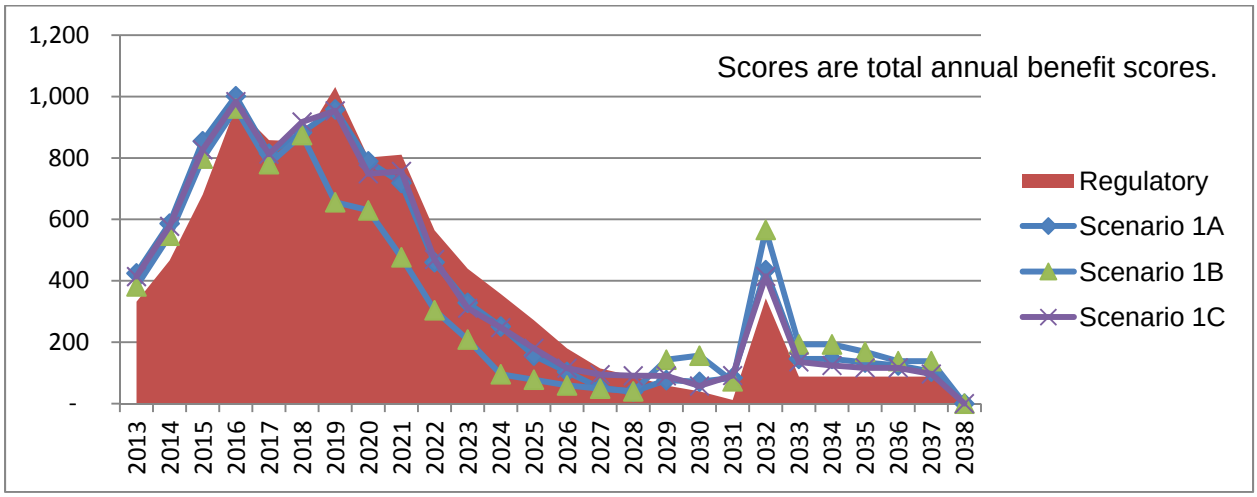


Figure 6.10. Total Annual Benefit Score

7 FINANCIAL ANALYSIS

7.1 Rationale

A key component of the City's IPF effort involves incorporating the project selection model results with the City's financial planning model to determine the impacts of the proposed scenarios on the Bureau's financial planning and on customer rates. The financial planning model is designed to calculate user rates and charges that are sufficient to achieve the following objectives:

- Meet annual operating costs of the system;
- Fund necessary capital improvements with a mixture of revenues (PAYGO) and long term debt;
- Maintain debt service coverage ratios and reserve fund balances that are consistent with City policy; and
- Provide an affordable rate structure to ensure sustainability of utility operations and service levels.

The financial planning model was modified to facilitate analysis of the IPF results based on these objectives. It is critical to consider the financial impacts of the proposed scenarios as capital spending continues to be the single largest driver in the Bureau's long term financial plan. The model projects all of the cash needs that are required to fund the operation of the system and fund the capital investment plan as derived through the IPF process. A major output of the model for this analysis is the impact IPF planned investments have on customer affordability.

7.2 Historical Perspective and Baltimore's Approach

Rate affordability is not merely an abstract concept; charging rates that many customers cannot afford to pay will result in real costs to the utility. These costs are in addition to the social issues and potential public health risks created when a segment of the population cannot afford access to clean water. Potential compounding risks that the utility may incur also include bill delinquency, revenue shortfalls, and customer conflicts. Despite a growing effort by industry leaders to reach consensus on some type of standardized affordability measurements, there remains an absence of agreement through the utility industry for a standardized set of affordability evaluation procedures or benchmarks. Thus, it has become the responsibility of each utility to adapt evaluation techniques and criteria on the basis of the utility's objectives, the availability of data, and the characteristics of the service area.

In 1997, the EPA developed a two-phased approach to assess the financial capability of municipalities and serve as guidance in determining appropriate implementation schedules for the capital improvements required to address combined sewer overflow (CSO) problems under its Control Policy. The EPA guidelines are used to determine a municipality's "Financial Capability Indicator" and "Residential Indicator." The Financial Capability Indicator measures a service area's ability to finance the necessary improvements by measuring property tax collection rate, unemployment levels, bond ratings, overall debt, and other regional metrics. Since it uses a broad range of criteria, it is an appropriate estimate for a utility's ability to take on the expenses related to compliance.

The Residential Indicator is calculated by determining a household's share of: (1) the current utility expenditures and (2) the total present value of costs related to compliance (capital and operating) as a percentage of service are median household income (MHI).

The City believes that EPA's guidelines for determining the Residential Indicator do not give full consideration to income distribution within a population and that an alternate approach is warranted. Calculating a household's share of total system costs must include the future costs related to non-compliance-related capital investment as every utility must make these investments to maintain a reliable and secure system. The City is utilizing the integrated planning framework to prioritize its overall capital needs and provide its customers with the most benefit per dollar invested. MHI has been used as a central component of EPA affordability measures since the 1997 report; however the MHI standard is met with objections from utilities and industry associations alike. The National Association of Clean Water Agencies ("NACWA") recently published a white paper declaring "the federal government's use of an area-wide MHI cannot accurately assess the impacts on this sensitive community population[19]" and "use of a median value by definition mutes consideration of important diversities across a permittee's served population."

The City had an MHI of $39,386 according to the 2010 US Census, which was an increase of 31 percent from the 2000 Census data.[20] Looking beyond just the city-wide MHI provides insight into how potential water and sewer costs will impact the full spectrum of utility customers, including seniors and low-income households. Approximately 26.2 percent of the City's population lives below the federal poverty line and approximately 12.3 percent of the City's population lives below half of the federal poverty line. Figure 7.1. Income Distribution shows the income distribution of City residents as a whole. It is clear that while the City-wide MHI may be $39,386, a large percentage of customers have significantly lower income levels.

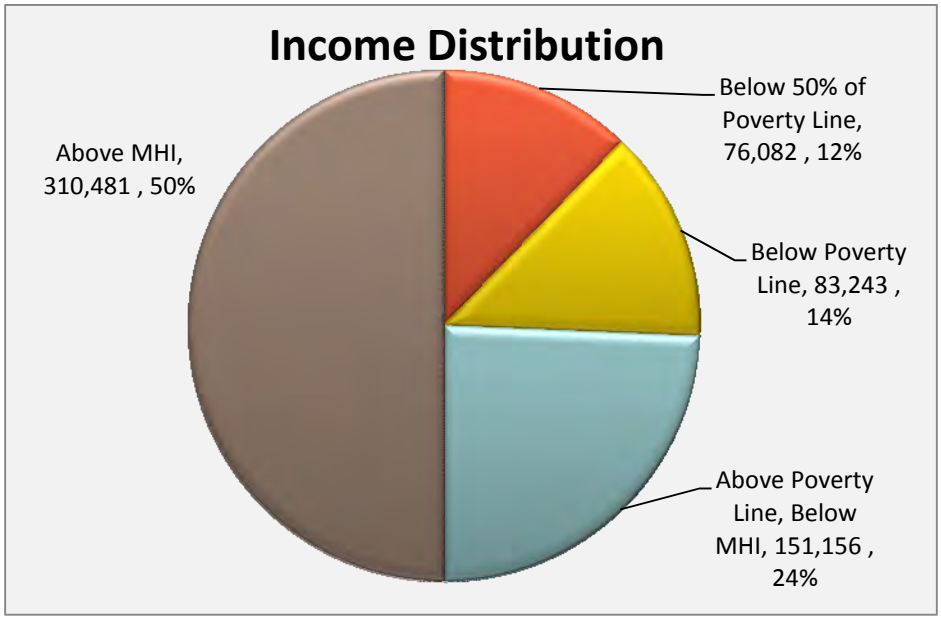


Figure 7.1. Income Distribution

[19] *Financial and Capability and Affordability in Wet Weather Negotiations*, NACWA, CHM2Hill, October 2005.
[20] U.S. Census Bureau, *American Fact Finder*, (2010, 12 1).

Baltimore City demographics illustrate a flaw in simply using service area MHI as a key indicator in determining affordability. The City compiled results from the 2010 US Census to examine how income levels were distributed within City limits. Figure 7.2. Baltimore City Income Distribution presents the percentage of households at each income increment and Figure 7.3. Cumulative Baltimore City Income Distribution presents the cumulative percentage of households at each income increment. It is important to note the ranges are larger at higher income levels.

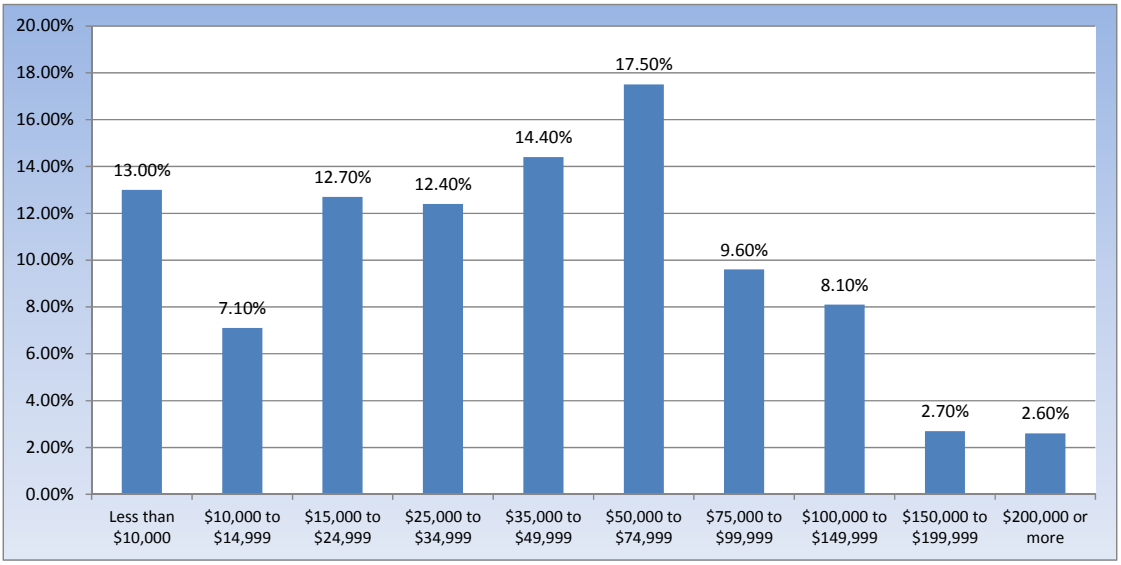


Figure 7.2. Baltimore City Income Distribution

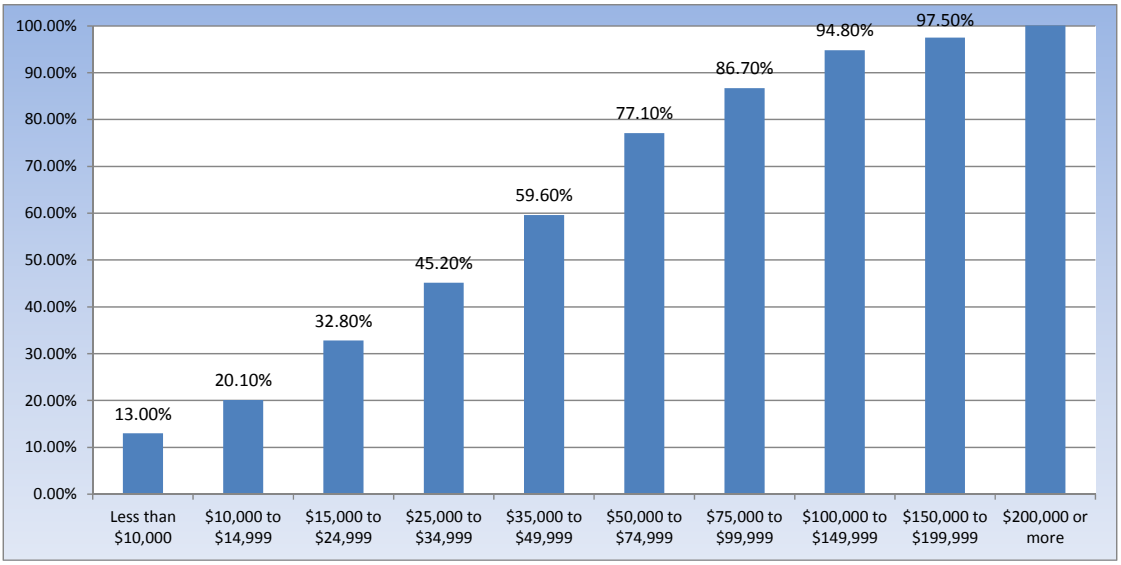


Figure 7.3. Cumulative Baltimore City Income Distribution

Analysis of the service area income distribution shows that household incomes are not normally distributed around the center median. There is a large percentage of households with very low income levels, and a very long tail of high income households. Assuming $30,000 for annual household income would set the tipping point for determining unaffordable utility costs at the 39th percentile of City household incomes. The City believes this is more appropriate than the

citywide MHI due to its residents' demographics and income distribution. The IPF Team has calculated current and projected affordability for each census tract within the service area to enhance and provide further context to the median household income. This data allows City officials to see where the most impacted customers live and who they are in a general sense so that targeted assistance and safety net programs can be developed.

Two versions of the financial planning model were developed for analyzing the IPF prioritized project list. The first version of the model is based on the assumption that the proposed capital projects would be fully funded according to the current schedule and spending rate as prepared by the PMT (this is referred to as the "Regulatory Scenario"). The Regulatory Scenario projects annual capital investment by the City of approximately $275 million annually (in present value dollars) for total capital spending of $5.5 billion by FY32. Rates were adjusted as needed to meet the requirements of the full capital costs. The second scenario analyzed with the financial planning model assumes the City will invest approximately $229 million annually in its capital program for a total of approximately $4.5 billion in capital investment by FY32 (this is referred to as "Scenario 1B". Rates were adjusted as needed to meet the requirements of the full capital costs).

These levels of capital investment are further augmented by capital projects completed in and funded by Baltimore County. Average annual capital investment by both the City and County is approximately $366 million under the Regulatory Scenario and $287 million in Scenario 1B. The financial analysis is detailed in Appendix F and summarized in the remainder of this Section 7.

7.3 Regulatory Scenario Results

Meeting the capital financing requirements of the Regulatory Scenario requires the City to increase water and sewer rates beyond the 9 percent annual rate increases that have been typical for the last several years. The projected capital funding needs are met by a mixture of long term debt (revenue bonds) and revenue funded capital (PAYGO). Future rate increases are determined by the requirements to meet the operating cash needs of the system and maintain the City's debt coverage at policy-defined levels. Table 7.1 presents the capital needs and proposed financing sources for the utility over the planning period. A schedule of the capital projects that will be completed over the forecast is included in Appendix D.

Between FY13 and FY30, the total capital investment made by the City and Baltimore County is $6.8 billion. The City's share of the total water capital investment between FY13 and FY30 is $3.35 billion, which would be funded using approximately 76 percent long term debt (revenue bonds) and 24 percent PAYGO. The City's share of the total wastewater capital investment between FY13 and FY30 is $2.00 billion, which would be funded using approximately 73 percent long term debt and 27 percent PAYGO. Under the Regulatory Scenario, Consent Decree related work is scheduled to be completed in FY23. Future debt issues have been forecast based on a 30-year term with a 5.5 percent interest rate and 6.0 percent issuance costs (which includes funding of the debt service reserve fund as required by the Indenture). The City policy is to maintain 140 percent coverage on its senior lien debt. The PAYGO funding level is targeted at a minimum of 10 percent; however, the actual funding level is driven by revenue that is available after the debt coverage ratios have been met. In other words, maintaining 140 percent senior lien debt coverage results in additional revenue that is available to be used as PAYGO capital in the amounts shown for water and wastewater.

These capital funding needs are integrated with the financial planning model to determine the necessary rate increases based on the City's policies and objectives. The financial plan results

for the water utility are presented in Table 7.2. **Status Quo Water Financial Plan FY 13 – FY 21**. The projected annual rate increases are shown on line 23; the cumulative impact of the projected increases on the water rates is greater than a 146 percent total increase between FY13 and FY24.

The financial plan results for the wastewater utility are presented in **Error! Reference source not found.**. The projected annual rate increases are shown on line 23; the cumulative impact of the projected increases on the wastewater rates is greater than a 99 percent total increase between FY13 and FY24.

Table 7.1. Regulatory Scenario Approach Capital Financing Plan

Water Capital Financing Plan	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Capital Financing Needs									
Water Utilities Projects	157,830,286	162,830,286	162,830,286	96,622,955	[redacted]				
Water Facilities Projects	150,457,951	152,757,951	152,924,618	150,080,689					
Subtotal: Capital Needs	$ 308,288,237	$ 315,588,237	$ 315,754,904	$ 246,703,644	$ [redacted]				
Capital Financing Sources									
Revenue Bond Proceeds	47,535,584	188,200,000	184,500,000	139,000,000	[redacted]				
Revenue Financed Capital (PAYGO) - Water Util	3,750,000	7,000,000	11,000,000	17,000,000					0
SRF Loans	-	-	-	-	-	-	-	-	-
County Grants	116,254,871	120,404,871	120,404,871	91,066,579	[redacted]				
Subtotal: Capital Sources	$ 167,540,455	$ 315,604,871	$ 315,904,871	$ 247,066,579	$ [redacted]				
Wastewater Capital Financing Plan									
Capital Financing Needs									
Wastewater Utilities Projects	133,729,072	133,729,072	130,659,904	127,273,914	[redacted]				
Wastewater Facilities Projects	91,977,630	91,977,630	89,437,630	88,064,019					
Subtotal: Capital Needs	$ 225,706,702	$ 225,706,702	$ 220,097,534	$ 215,337,933	$ [redacted]				
Capital Financing Sources									
Revenue Bond Proceeds	28,239,955	40,250,000	115,250,000	108,400,000	[redacted]				
Revenue Financed Capital (PAYGO) - Wastewat	3,750,000	9,200,000	13,250,000	16,000,000					
SRF Loans	36,616,261	82,095,000	-	-	-	-	-	-	-
County Grants	94,184,622	94,184,622	91,773,338	90,984,449	[redacted]				
Subtotal: Capital Sources	$ 162,790,838	$ 225,729,622	$ 220,273,338	$ 215,384,449	$ [redacted]				

Water Capital Financing Plan	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Capital Financing Needs									
Water Utilities Projects	[redacted]								
Water Facilities Projects									
Subtotal: Capital Needs	$ [redacted]								
Capital Financing Sources									
Revenue Bond Proceeds	[redacted]								
Revenue Financed Capital (PAYGO) - Water Util									
SRF Loans	-	-	-	-	-	-	-	-	-
County Grants	[redacted]								
Subtotal: Capital Sources	$ [redacted]								
Wastewater Capital Financing Plan									
Capital Financing Needs									
Wastewater Utilities Projects	[redacted]								
Wastewater Facilities Projects									
Subtotal: Capital Needs	$ [redacted]								
Capital Financing Sources									
Revenue Bond Proceeds	[redacted]								
Revenue Financed Capital (PAYGO) - Wastewat									
SRF Loans	-	-	-	-	-	-	-	-	-
County Grants	[redacted]								
Subtotal: Capital Sources	$ [redacted]								

Table 7.2. Status Quo Water Financial Plan FY 13 – FY 21

(a) FY13 – FY21

		FY 2013 Budget	FY 2014 Projected	FY 2015 Projected	FY 2016 Projected	FY 2017 Projected	FY 2018 Projected	FY 2019 Projected	FY 2020 Projected	FY 2021 Projected
	Water System Revenues									
1.	Baltimore City User Charges	$ 67,488,057	$ 80,175,823	$ 95,248,870	$ 111,269,840	$				
2.	Baltimore County Revenue	52,629,501	55,381,255	57,431,731	59,243,996					
3.	Other County Revenue	15,600,750	18,185,900	21,288,080	24,638,434					
4.	Miscellaneous Revenues	15,901,959	17,130,310	18,591,744	20,171,341					
5.	Interest Income	307,000	365,000	452,000	539,000					
6.	Allowance for Bad Debt	(1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)					)
7.	Transfers (to)/from Rate Stabilization Fund	-	-	-	-	-	-	-	-	-
8.	Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
9.	***Total: Water Revenues***	**$ 150,077,266**	**$ 169,388,287**	**$ 191,162,424**	**$ 214,012,611**	$				
	Revenue Requirements									
10.	Operations & Maintenance Expense	$ 111,573,676	$ 117,351,820	$ 121,341,639	$ 125,465,980	$				
11.	Net Operating Revenue for Debt Service	$ 38,503,590	$ 52,036,468	$ 69,820,785	$ 88,546,631	$				
	Debt Service									
	Senior Lien									
12.	Existing	$ 27,334,613	$ 26,875,682	$ 27,054,913	$ 26,834,361	$				
13.	Proposed	-	9,476,699	22,546,279	33,955,234					
14.	*Subtotal: Senior Lien Debt*	$ 27,334,613	$ 36,352,381	$ 49,601,192	$ 60,789,595	$				
	Subordinate									
15.	Existing	$ 6,680,219	$ 7,113,524	$ 7,132,480	$ 8,125,240	$				
16.	Proposed	-	-	-	-	-	-	-	-	-
17.	*Subtotal: Subordinate Lien Debt*	6,680,219	7,113,524	7,132,480	8,125,240					8
18.	*Subtotal: Debt Service*	$ 34,014,832	$ 43,465,905	$ 56,733,672	$ 68,914,835					
19.	Revenue Financed Capital (PAYGO)	$ 3,750,000	$ 7,000,000	$ 11,000,000	$ 17,000,000	$				
20.	Other Expenses	696,573	693,333	687,393	680,913					
21.	**Total Revenue Requirements**	**$ 150,035,081**	**$ 168,511,057**	**$ 189,762,704**	**$ 212,061,728**	$				
22.	***Total Surplus / (Deficit)***	**$ 42,185**	**$ 877,230**	**$ 1,399,720**	**$ 1,950,883**	$				
23.	***Water Rate Adjustment***	9.0%	20.0%	20.0%	18.0%					
	Reserve Fund Balance									
24.	Total Cash Balance	$ 47,862,344	$ 47,862,345	$ 47,862,346	$ 47,862,347	$				
25.	# Days of O&M (Target 120 Days)	94	92	94	96					
	Debt Service Coverage									
	Senior Lien									
26.	Actual	**1.41**	**1.43**	**1.41**	**1.46**					
27.	Target	1.40	1.40	1.40	1.40					
	Total Debt									
28.	Actual	**1.13**	**1.20**	**1.23**	**1.28**					
29.	Target	1.10	1.10	1.10	1.10					

(b) FY22 – FY30

		FY 2022 Projected	FY 2023 Projected	FY 2024 Projected	FY 2025 Projected	FY 2026 Projected	FY 2027 Projected	FY 2028 Projected	FY 2029 Projected	FY 2030 Projected
	Water System Revenues									
1.	Baltimore City User Charges	$ [redacted]								
2.	Baltimore County Revenue	[redacted]								
[redacted]	[redacted]									
4.	Miscellaneous Revenues									
5.	Interest Income									
6.	Allowance for Bad Debt	[redacted]1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)	[redacted]	[redacted])
7.	Transfers (to)/from Rate Stabilization Fund	-	-	-	-	-	-	-	-	-
8.	Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
9.	***Total: Water Revenues***	$ [redacted]								
	Revenue Requirements									
10.	Operations & Maintenance Expense	$ [redacted]								
11.	Net Operating Revenue for Debt Service	$ [redacted]								
	Debt Service									
	Senior Lien									
12.	Existing	$ [redacted]								
13.	Proposed	[redacted]								
14.	*Subtotal: Senior Lien Debt*	$ [redacted]								
	Subordinate									
15.	Existing	$ [redacted]								
16.	Proposed	-	-	-	-	-	-	-	-	-
17.	*Subtotal: Subordinate Lien Debt*	[redacted]								
18.	*Subtotal: Debt Service*	$ [redacted]								
19.	Revenue Financed Capital (PAYGO)	$ [redacted]								
20.	Other Expenses	[redacted]								
21.	**Total Revenue Requirements**	$ [redacted]								
22.	***Total Surplus / (Deficit)***	$ [redacted]								
23.	***Water Rate Adjustment***	[redacted]								
	Reserve Fund Balance									
24.	Total Cash Balance	$ [redacted]								
25.	# Days of O&M (Target 120 Days)	[redacted]								
	Debt Service Coverage									
	Senior Lien									
26.	Actual	[redacted]								
27.	Target	[redacted]								
	Total Debt									
28.	Actual	[redacted]								
29.	Target	[redacted]								

Table 7.3 Regulatory Scenario Wastewater Financial Plan

(a) FY13 – FY21

		FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
	Wastewater System Revenues									
1.	Baltimore City User Charges	$ 111,179,304	$ 125,476,830	$ 140,371,213	$ 151,474,461	$				
2.	Counties Sewer Charges	61,054,624	67,100,682	68,425,838	70,815,271					
3.	Industrial Waste Surcharges	5,202,945	5,463,093	5,736,247	6,023,060					
4.	Miscellaneous Revenues	16,629,573	18,591,728	20,635,738	22,159,519					
5.	Interest Income	205,000	182,000	168,000	209,000					
6.	Allowance for Bad Debt	(2,000,000)	(2,000,000)	(2,000,000)	(2,000,000)					)
7.	Transfers (to)/from Rate Stabilization Fund	1,400,000	-	-	-	-	-	-	-	-
8.	Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
9.	***Total: Wastewater Revenues***	**$ 193,671,446**	**$ 214,814,332**	**$ 233,337,037**	**$ 248,681,311**	$				
	Revenue Requirements									
10.	Operations & Maintenance Expense	$ 133,889,503	$ 147,001,078	$ 151,611,089	$ 156,406,881	$				
11.	Net Operating Revenue for Debt Service	$ 59,781,943	$ 67,813,254	$ 81,725,948	$ 92,274,431	$				
	Wastewater Debt Service									
	Senior Lien									
12.	Existing	$ 42,662,579	$ 41,925,409	$ 42,281,799	$ 42,265,101	$				
13.	Proposed	-	4,553,486	13,687,140	21,574,661					
14.	*Subtotal: Senior Lien Debt*	42,662,579	46,478,895	55,968,939	63,839,762					
	Subordinate									
15.	Existing	$ 9,866,968	$ 10,184,353	$ 10,157,453	$ 10,933,453	$				
16.	Proposed	-	-	-	-	-	-	-	-	-
17.	*Subtotal: Subordinate Lien Debt*	9,866,968	10,184,353	10,157,453	10,933,453					
18.	*Subtotal: Wastewater Debt Service*	$ 52,529,547	$ 56,663,248	$ 66,126,392	$ 74,773,215	$				
19.	Revenue Financed Capital (PAYGO)	$ 3,750,000	$ 9,200,000	$ 13,250,000	$ 16,000,000	$				
20.	Other Expenses	1,359,000	1,357,000	1,354,000	1,302,000					
21.	**Total Revenue Requirements**	**$ 191,528,050**	**$ 214,221,326**	**$ 232,341,481**	**$ 248,482,096**	$				
22.	***Total Surplus / (Deficit)***	**$ 2,143,396**	**$ 593,006**	**$ 995,556**	**$ 199,216**	$				
23.	***Wastewater Rate Adjustment***	9.0%	14.0%	13.0%	9.0%					
	Fund Balance									
24.	Total Cash Balance	$ 68,995,323	$ 69,588,329	$ 70,583,884	$ 70,783,100	$				
25.	# Days of O&M (Target 120 Days)	122	113	112	109					
	Debt Service Coverage									
	Senior Lien									
26.	Actual	**1.40**	**1.46**	**1.46**	**1.45**					
27.	Target	1.40	1.40	1.40	1.40					
	Total Debt									
28.	Actual	**1.14**	**1.20**	**1.24**	**1.23**	1				
29.	Target	1.10	1.10	1.10	1.10					

(b) FY22 – FY30

		FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
	Wastewater System Revenues									
1.	Baltimore City User Charges	$ [redacted]								
2.	Counties Sewer Charges	[redacted]								
3.	Industrial Waste Surcharges	[redacted]								
4.	Miscellaneous Revenues	[redacted]								
5.	Interest Income	[redacted]								
6.	Allowance for Bad Debt	[redacted]								
7.	Transfers (to)/from Rate Stabilization Fund	-	-	-	-	-	-	-	-	-
8.	Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
9.	***Total: Wastewater Revenues***	$ [redacted]								
	Revenue Requirements									
10.	Operations & Maintenance Expense	$ [redacted]								
11.	Net Operating Revenue for Debt Service	$ [redacted]								
	Wastewater Debt Service									
	Senior Lien									
12.	Existing	$ [redacted]								
13.	Proposed	[redacted]								
14.	*Subtotal: Senior Lien Debt*	[redacted]								
	Subordinate									
15.	Existing	$ [redacted]								
16.	Proposed	-	-	-	-	-	-	-	-	-
17.	*Subtotal: Subordinate Lien Debt*	[redacted]								
18.	*Subtotal: Wastewater Debt Service*	$ [redacted]								
19.	Revenue Financed Capital (PAYGO)	$ [redacted]								
20.	Other Expenses	[redacted]								
21.	**Total Revenue Requirements**	$ [redacted]								
22.	***Total Surplus / (Deficit)***	$ [redacted]								
23.	***Wastewater Rate Adjustment***	[redacted]								
	Fund Balance									
24.	Total Cash Balance	$ [redacted]								
25.	# Days of O&M (Target 120 Days)	[redacted]								
	Debt Service Coverage									
	Senior Lien									
26.	Actual	[redacted]								
27.	Target	[redacted]								
	Total Debt									
28.	Actual	[redacted]								
29.	Target	[redacted]								

7.4 Regulatory Scenario Customer Impacts

The financial plans presented in Table 7.2. Status Quo Water Financial Plan FY 13 – FY 21 and **Error! Reference source not found.** identify rate increases necessary to fully fund the capital needs of the Regulatory Scenario approach over the planning horizon. The impacts of this analysis cannot be viewed in the "vacuum" of the financial planning model without taking into account the burden the proposed rate increases place on the City's residents. The industry standard benchmark for customer affordability is based on the EPA *Guidance for Financial Capability*[21] which allows for a total of 4.0 percent of a municipality's Median Household Income ("MHI") to be spent on annual water and sewer costs before becoming unaffordable.

To determine customer impacts and affordability, the annual rate increases shown in Table 7.2. Status Quo Water Financial Plan FY 13 – FY 21 and **Error! Reference source not found.** are applied to the current water and sewer rates. The projected rates are then used to calculate quarterly (and annual) water and sewer bills for typical customers. Customer impacts were analyzed at two quarterly usage levels:

- City design-based standard for a family of four, 39 hundred cubic feet ("ccf") or approximately 29,200 gallons per quarter.
- Residential average usage, 21 ccf, or approximately 15,700 gallons, per quarter.

The City has also included a flat quarterly stormwater charge in the customer's annual cost calculation. Projected customer rates and detailed customer impact information are included in Appendix F. The customer impacts from the Regulatory Scenario approach show the following outcomes:

- Customer's annual water and sewer costs will increase by approximately 277 percent by FY30.
- Assuming 39 ccf (Baltimore design-based standard for family of four) of quarterly water consumption:
    - Annual water and sewer costs become unaffordable in FY15 (4.1 percent) and represent 7.6 percent of City-wide MHI in FY30.
    - Annual water and sewer costs are unaffordable in FY13 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 10.2 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs are unaffordable for 28 percent of the City's census tracts in FY13 (representing approximately 23 percent of the City's population). By FY23, water and sewer costs would be classified as unaffordable for 90 percent of the City's census tracts (87.5 percent of the City's population).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs are already unaffordable. Customers spend approximately 6.8 percent of their income on water and sewer in FY13; this increases to approximately 17 percent of their annual income on water and sewer by FY30.
        - This group includes 25% of families with children under five years old.

[21] U.S. Environmental Protection Agency, *Combined Sewer Overflows, Guidance for Financial Capability Assessment and Schedule Development*, 1997.

  - 39 percent of all households are spending 4.1 percent of annual income on water and sewer costs in FY13.

- Assuming 21 ccf (residential average) of quarterly water consumption:
  - Annual water and sewer costs represent 4.0 percent of City-wide MHI by FY26.
  - Annual water and sewer costs become unaffordable in FY16 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 6.8 percent of annual income for 39% of households in FY30.
  - Annual water and sewer costs become unaffordable for 53 percent of the City's census tracts by FY23 (representing approximately 47.7percent of the City's population).
  - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs represent 3.8 percent of income in FY13. Customers will spend approximately 9.5 percent of their annual income on water and sewer by FY30.
  - The annual water and sewer costs are already unaffordable for the 77,000 people currently living below 50 percent of the federal poverty line, and account for nearly 8 percent of their income.
  - 27 percent of all families will be spending 4.4 percent of annual income on water and sewer costs in FY16.
- These results are summarized in **Error! Reference source not found.**Figure 7.4 . Status Quo Water and Sewer Affordability at 39 ccf/quarter, Figure 7.5. Status Quo Costs Compared to 4% of MHI for Population Percentages, Figure 7.6. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Regulatory Scenario, Figure 7.7. Regulatory Scenario Water and Sewer Affordability at 21 ccf/quarter, Figure 7.8. Regulatory Scenario Costs Compared to 4% of MHI for Population Percentages, and Figure 7.9. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption – Regulatory Scenario. Figure 7.6. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Regulatory Scenario and Figure 7.9. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption – Regulatory Scenario are maps depicting the City's census tracts and their unique affordability status at the end of the forecast period. A red census tract district is unaffordable based on its individual MHI.

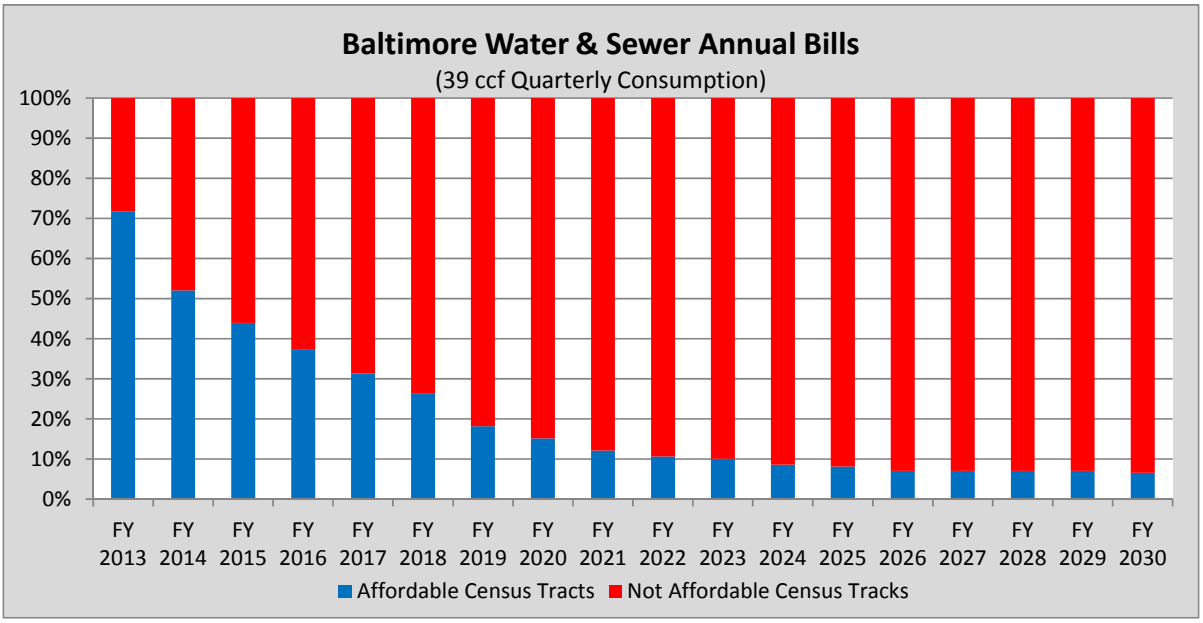


Figure 7.4 . Status Quo Water and Sewer Affordability at 39 ccf/quarter

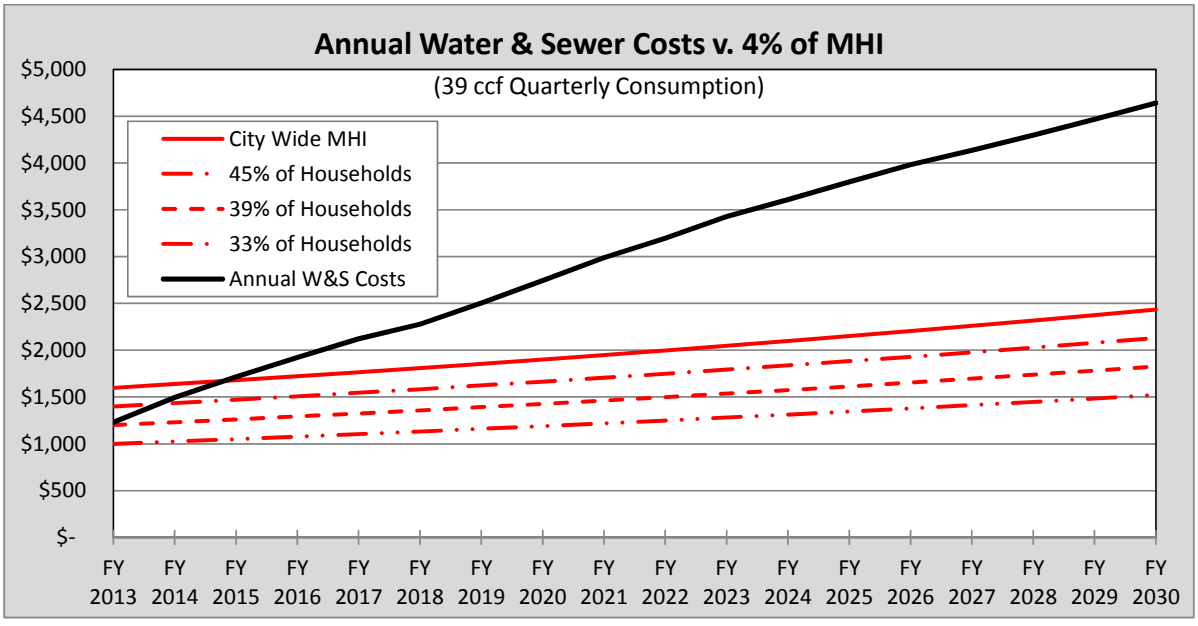


Figure 7.5. Status Quo Costs Compared to 4% of MHI for Population Percentages

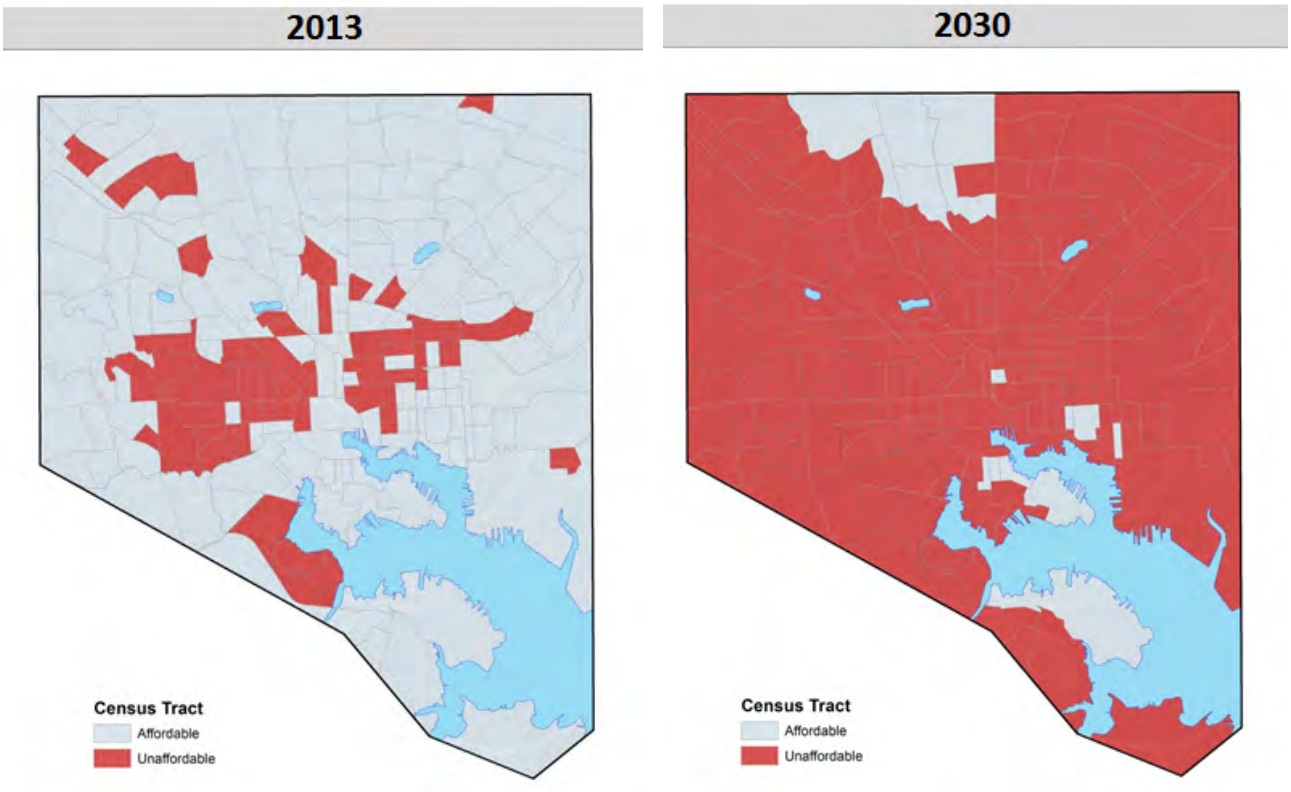


Figure 7.6. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Regulatory Scenario

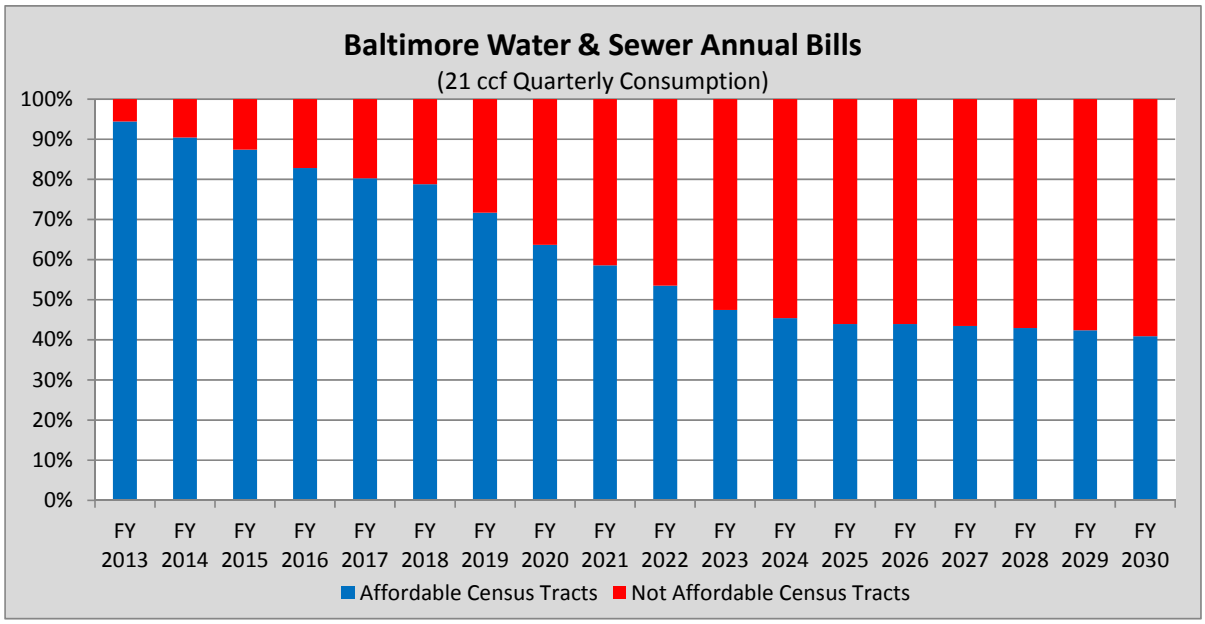


Figure 7.7. Regulatory Scenario Water and Sewer Affordability at 21 ccf/quarter

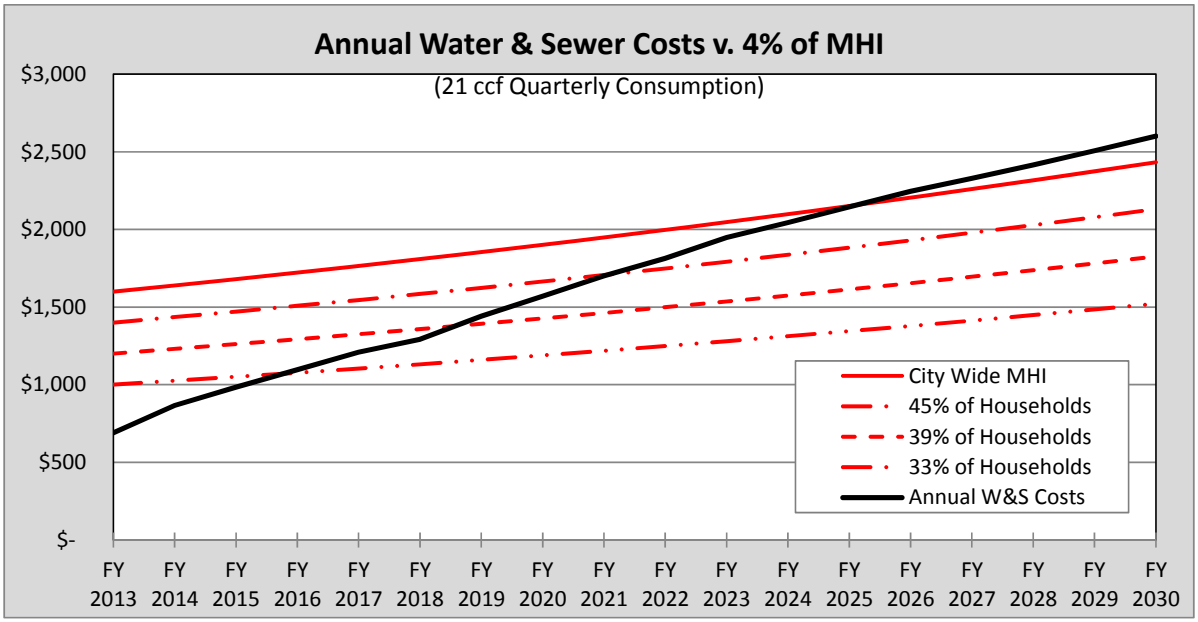


Figure 7.8. Regulatory Scenario Costs Compared to 4% of MHI for Population Percentages

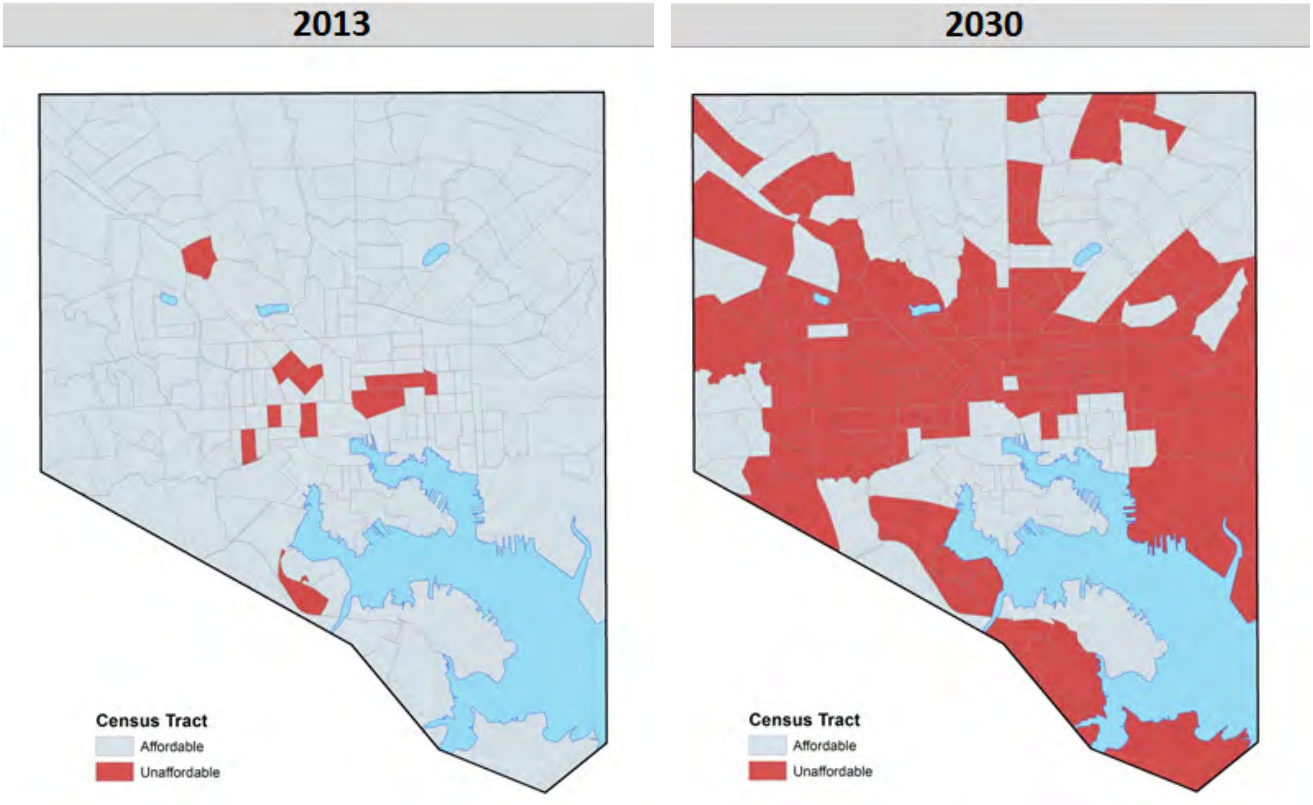


Figure 7.9. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption – Regulatory Scenario

7.5 Scenario 1B Results

This approach limits the City to approximately $250 million of annual capital investment (in present value dollars) with an average annual spend rate of $228 million. The financial planning model is used to determine the amount of capital financing (PAYGO and long term debt) that must be included in each year of the forecast and the rate increases required to fund the capital plan. Scheduling of the capital projects has been adjusted from the Regulatory Scenario to account for the reduced spending amounts. As a result of limiting the capital investment, some capital projects are delayed beyond the planning horizon, but all Consent Decree related projects are finished by FY32. Table 7.5 Scenario 1B Water Financial Plan shows the capital needs and proposed financing sources for the water and wastewater utilities over the planning period under Scenario 1B. Detailed schedules of the modified capital projects and timing that will be funded under the scenarios are provided in Appendix D.

The City's total water capital investment between FY13 and FY30 is $2.77 billion, which will be funded with approximately 87 percent long term debt (revenue bonds) and 13 percent PAYGO. Total wastewater capital investment between FY13 and FY30 is $1.74 billion, which will be funded with approximately 75 percent long term debt and 25 percent PAYGO. Future debt issues have been forecast based on a 30-year term with a 5.5 percent interest rate and 6.0 percent issuance costs (which includes funding of debt the service reserve fund required by the Indenture). The financial plan results for the water and wastewater utilities are presented in Table 7.5 Scenario 1B Water Financial Plan and Table 7.6 Scenario 1B Wastewater Financial Plan, respectively. The projected annual rate increases are shown on line 23; the cumulative impact of the projected increases on the water and wastewater rates are greater than a 162 percent and 119 percent total increase between FY13 and FY30.

Table 7.4. Scenario 1B Capital Financing Plan

Water Capital Financing Plan	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Capital Financing Needs									
Water Utilities Projects	100,188,543	160,018,957	160,018,957	152,681,570					
Water Facilities Projects	95,456,432	95,456,432	98,930,879	92,679,212					
Subtotal: Capital Needs	$ 195,644,974	$ 255,475,388	$ 258,949,836	$ 245,360,782	$				
Capital Financing Sources									
Revenue Bond Proceeds	47,535,584	152,000,000	153,500,000	139,000,000					
Revenue Financed Capital (PAYGO) - Water Util	3,750,000	7,000,000	9,000,000	12,300,000					
Subtotal: Capital Sources	$ 121,014,473	$ 255,583,180	$ 259,083,180	$ 245,399,180	$				
Wastewater Capital Financing Plan									
Capital Financing Needs									
Wastewater Utilities Projects	84,269,885	84,269,885	81,200,717	77,814,727					
Wastewater Facilities Projects	60,894,523	60,894,523	66,906,557	64,795,446					
Subtotal: Capital Needs	$ 145,164,408	$ 145,164,408	$ 148,107,274	$ 142,610,173	$				
Capital Financing Sources									
Revenue Bond Proceeds	28,239,955	-	71,000,000	64,000,000					
Revenue Financed Capital (PAYGO) - Wastewat	3,750,000	5,000,000	7,500,000	10,000,000					
Subtotal: Capital Sources	$ 136,774,648	$ 155,263,432	$ 148,400,898	$ 142,845,342	$				

Water Capital Financing Plan	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Capital Financing Needs									
Water Utilities Projects									
Water Facilities Projects									
Subtotal: Capital Needs	$								
Capital Financing Sources									
Revenue Bond Proceeds									
Revenue Financed Capital (PAYGO) - Water Util									
Subtotal: Capital Sources									
Wastewater Capital Financing Plan									
Capital Financing Needs									
Wastewater Utilities Projects									
Wastewater Facilities Projects									
Subtotal: Capital Needs	$								
Capital Financing Sources									
Revenue Bond Proceeds									
Revenue Financed Capital (PAYGO) - Wastewat									
Subtotal: Capital Sources	$								

Table 7.5 Scenario 1B Water Financial Plan

(a) FY13 – FY21

	FY 2013 Budget	FY 2014 Projected	FY 2015 Projected	FY 2016 Projected	FY 2017 Projected	FY 2018 Projected	FY 2019 Projected	FY 2020 Projected	FY 2021 Projected
Water System Revenues									
Baltimore City User Charges	$ 67,488,057	$ 79,507,723	$ 92,093,870	$ 104,848,740	$ [redacted]				
Baltimore County Revenue	52,629,501	55,381,255	57,431,731	59,243,996					
Other County Revenue	15,600,750	18,056,642	20,671,521	23,371,000					
Miscellaneous Revenues	15,901,959	17,074,613	18,326,073	19,625,210					
Interest Income	307,000	365,000	452,000	539,000					
Allowance for Bad Debt	(1,850,000)	(1,850,000)	(1,850,000)	(1,850,000)					
Transfers (to)/from Rate Stabilization Fund	-	-	-	-	-	-	-	-	-
Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
Total: Water Revenues	**$ 150,077,266**	**$ 168,535,233**	**$ 187,125,195**	**$ 205,777,947**	**$** [redacted]				
Revenue Requirements									
Operations & Maintenance Expense	$ 111,573,676	$ 117,351,820	$ 121,341,639	$ 125,465,980	$ [redacted]				
Net Operating Revenue for Debt Service	$ 38,503,590	$ 51,183,414	$ 65,783,555	$ 80,311,966	$ [redacted]				
Debt Service									
Senior Lien									
Existing	$ 27,334,613	$ 26,875,682	$ 27,054,913	$ 26,834,361	$ [redacted]				
Proposed	-	8,214,359	18,928,315	29,243,985					
Subtotal: Senior Lien Debt	27,334,613	35,090,041	45,983,228	56,078,346					
Subordinate									
Existing	$ 6,680,219	$ 7,113,524	$ 7,132,480	$ 8,125,240	$ [redacted]				
Proposed	-	-	-	-	-	-	-	-	-
Subtotal: Subordinate Lien Debt	6,680,219	7,113,524	7,132,480	8,125,240					
Subtotal: Debt Service	$ 34,014,832	$ 42,203,565	$ 53,115,708	$ 64,203,586	$ [redacted]				
Revenue Financed Capital (PAYGO)	$ 3,750,000	$ 7,000,000	$ 9,000,000	$ 12,300,000	$ [redacted]				
Other Expenses	696,573	693,333	687,393	680,913					
Total Revenue Requirements	**$ 150,035,081**	**$ 167,248,717**	**$ 184,144,740**	**$ 202,650,479**	**$** [redacted]				
Total Surplus / (Deficit)	**$ 42,185**	**$ 1,286,516**	**$ 2,980,455**	**$ 3,127,468**	**$** [redacted]				
Water Rate Adjustment	9.0%	19.0%	17.0%	15.0%	[redacted]				
Reserve Fund Balance									
Total Cash Balance	$ 47,862,344	$ 47,862,345	$ 47,862,346	$ 47,862,347	$ [redacted]				
# Days of O&M (Target 120 Days)	94	94	100	105					
Debt Service Coverage									
Senior Lien									
Actual	**1.41**	**1.46**	**1.43**	**1.43**	[redacted]				
Target	1.40	1.40	1.40	1.40					
Total Debt									
Actual	**1.13**	**1.21**	**1.24**	**1.25**	[redacted]				
Target	1.10	1.10	1.10	1.10					

(b) FY 2022 – FY 2030

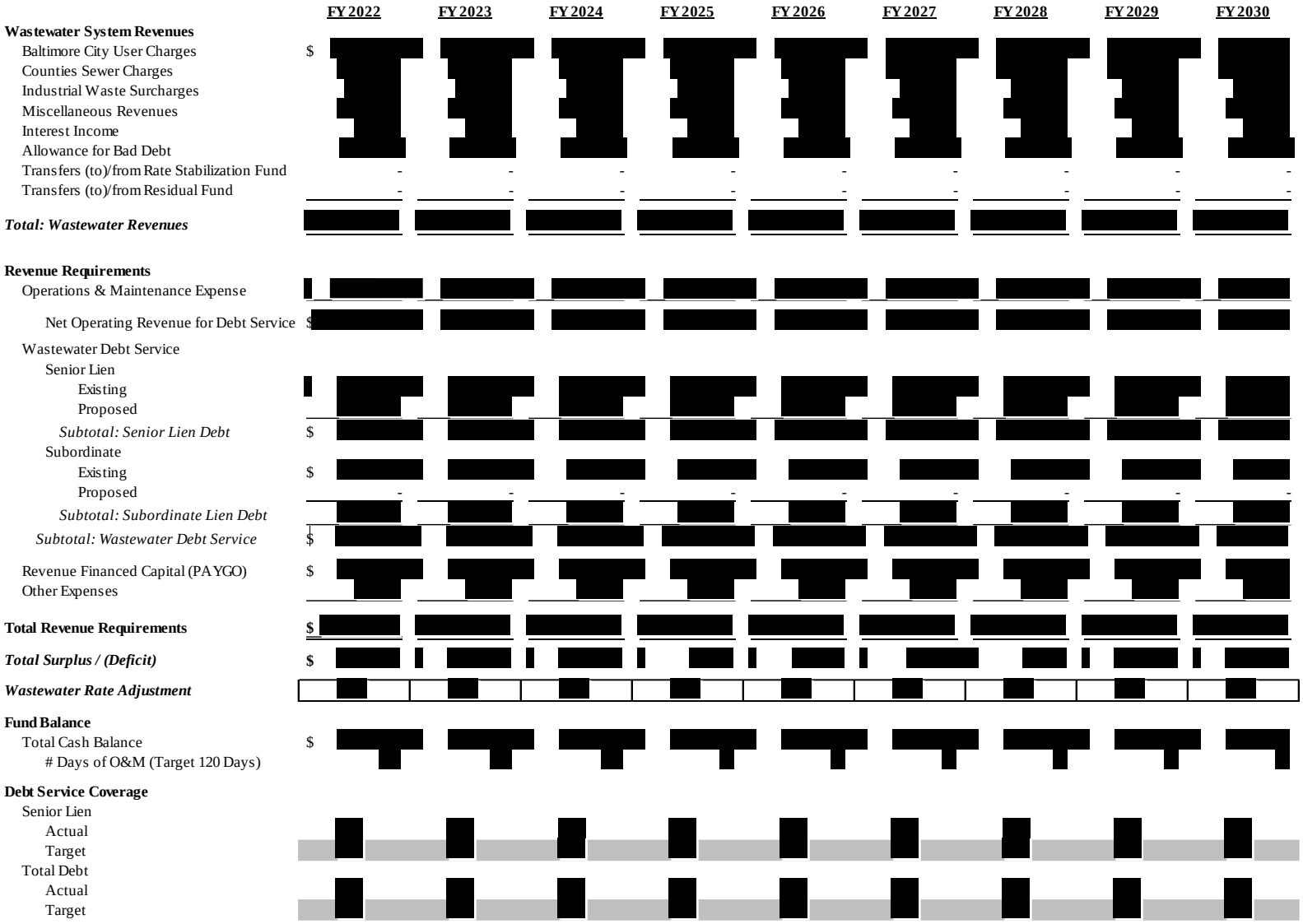
	FY 2022 Projected	FY 2023 Projected	FY 2024 Projected	FY 2025 Projected	FY 2026 Projected	FY 2027 Projected	FY 2028 Projected	FY 2029 Projected	FY 2030 Projected
Water System Revenues									
Baltimore City User Charges	$ [redacted]								
Baltimore County Revenue	[redacted]								
Other County Revenue	[redacted]								
Miscellaneous Revenues	[redacted]								
Interest Income	[redacted]								
Allowance for Bad Debt	[redacted]								)
Transfers (to)/from Rate Stabilization Fund	-	-	-	-	-	-	-	-	-
Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
Total: Water Revenues	$ [redacted]								
Revenue Requirements									
Operations & Maintenance Expense	$ [redacted]								
Net Operating Revenue for Debt Service	$ [redacted]								
Debt Service									
Senior Lien									
Existing	$ [redacted]								
Proposed	[redacted]								
Subtotal: Senior Lien Debt	[redacted]								
Subordinate									
Existing	$ [redacted]								
Proposed	-	-	-	-	-	-	-	-	-
Subtotal: Subordinate Lien Debt	[redacted]								
Subtotal: Debt Service	$ [redacted]								
Revenue Financed Capital (PAYGO)	$ [redacted]								
Other Expenses	[redacted]								
Total Revenue Requirements	$ [redacted]								
Total Surplus / (Deficit)	[redacted]								
Water Rate Adjustment	[redacted]								
Reserve Fund Balance									
Total Cash Balance	$ [redacted]								
# Days of O&M (Target 120 Days)	[redacted]								
Debt Service Coverage									
Senior Lien									
Actual	[redacted]								
Target	[redacted]								
Total Debt									
Actual	[redacted]								
Target	[redacted]								

Table 7.6 Scenario 1B Wastewater Financial Plan

(a) FY 2013 – FY 2021

	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Wastewater System Revenues									
Baltimore City User Charges	$ 111,179,304	$ 124,376,230	$ 132,983,213	$ 142,185,561	$ [redacted]				
Counties Sewer Charges	61,054,624	67,100,682	68,425,838	70,815,271					
Industrial Waste Surcharges	5,202,945	5,463,093	5,736,247	6,023,060					
Miscellaneous Revenues	16,629,573	18,440,675	19,621,845	20,884,751					
Interest Income	205,000	182,000	168,000	209,000					
Allowance for Bad Debt	(2,000,000)	(2,000,000)	(2,000,000)	(2,000,000)					[redacted]
Transfers (to)/from Rate Stabilization Fund	1,400,000	(2,000,000)	(2,000,000)	-	-	-	-	-	-
Transfers (to)/from Residual Fund	-	-	-	-	-	-	-	-	-
Total: Wastewater Revenues	**$ 193,671,446**	**$ 211,562,680**	**$ 222,935,143**	**$ 238,117,643**	[redacted]				
Revenue Requirements									
Operations & Maintenance Expense	$ 133,889,503	$ 147,001,078	$ 151,611,089	$ 156,406,881	[redacted]				
Net Operating Revenue for Debt Service	$ 59,781,943	$ 64,561,602	$ 71,324,054	$ 81,710,762	[redacted]				
Wastewater Debt Service									
Senior Lien									
Existing	$ 42,662,579	$ 41,925,409	$ 42,281,799	$ 42,265,101	[redacted]				
Proposed	-	3,149,918	9,319,428	14,080,506					
Subtotal: Senior Lien Debt	$ 42,662,579	$ 45,075,327	$ 51,601,226	$ 56,345,608	[redacted]				
Subordinate									
Existing	$ 9,866,968	$ 10,184,353	$ 10,157,453	$ 10,933,453	[redacted]				
Proposed	-	-	-	-	-	-	-	-	-
Subtotal: Subordinate Lien Debt	9,866,968	10,184,353	10,157,453	10,933,453	[redacted]				
Subtotal: Wastewater Debt Service	$ 52,529,547	$ 55,259,680	$ 61,758,679	$ 67,279,061	$ [redacted]				
Revenue Financed Capital (PAYGO)	$ 3,750,000	$ 5,000,000	$ 7,500,000	$ 10,000,000	[redacted]				
Other Expenses	1,359,000	1,357,000	1,354,000	1,302,000					
Total Revenue Requirements	**$ 191,528,050**	**$ 208,617,758**	**$ 222,223,768**	**$ 234,987,941**	[redacted]				
Total Surplus / (Deficit)	**$ 2,143,396**	**$ 2,944,922**	**$ 711,375**	**$ 3,129,701**	$ [redacted]				
Wastewater Rate Adjustment	9.0%	13.0%	8.0%	8.0%	[redacted]				0%
Fund Balance									
Total Cash Balance	$ 68,995,323	$ 73,940,245	$ 76,651,619	$ 79,781,321	$ [redacted]				
# Days of O&M (Target 120 Days)	122	119	117	121					
Debt Service Coverage									
Senior Lien									
Actual	**1.40**	**1.43**	**1.38**	**1.45**	[redacted]				
Target	1.40	1.40	1.40	1.40					
Total Debt									
Actual	**1.14**	**1.17**	**1.15**	**1.21**	[redacted]				
Target	1.10	1.10	1.10	1.10					

(b) FY 2022 – FY 2030



7.6 Scenario 1B Customer Impacts

Table 7.5 Scenario 1B Water Financial Plan and Table 7.6 Scenario 1B Wastewater Financial Plan above summarize financial impacts of the Scenario 1B annual rate increases to the water and sewer rates throughout the forecast period. Capital financing is directly dependent upon future rate increases, and this scenario forces the delay in several projects across the capital improvement program. Compared to the Regulatory Scenario, Scenario 1B is unable to fund 18 of the lowest priority capital projects (based on the IPF results). The annual rate increases also have significant impacts on the City's customers that need to be examined under the same affordability light.

Projected customer rates and detailed customer impact information based on the Scenario 1B is included in Appendix F. The customer impacts from Scenario 1B show the following outcomes:

- Customer's annual water and sewer costs will increase by approximately 250 percent by FY30.
- Assuming 39 ccf (Baltimore design-based standard for family of four) of quarterly water consumption:
    - Annual water and sewer costs become unaffordable in FY16 (4.2 percent) and represent 7.0 percent of City-wide MHI in FY30.
    - Annual water and sewer costs are unaffordable in FY13 (4.1 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 9.4 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs are unaffordable for 43 percent of the City's census tracts in FY14 (representing approximately 39 percent of the City's population). By FY29, water and sewer costs would be classified as unaffordable for 90 percent of the City's census tracts (87.5 percent of the City's population).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs are already unaffordable. Customers spend approximately 6.8 percent of their income on water and sewer in FY13; this increases to approximately 15.7 percent of their annual income on water and sewer by FY30.
        - This group includes 25 percent of families with children under five years old.
    - 45 percent of all households (including 37 percent of families) will be spending 4.1 percent of annual income on water and sewer costs in FY14.
- Assuming 21 ccf (residential average) of quarterly water consumption:
    - Annual water and sewer costs represent 3.9 percent of City-wide MHI by FY30.
    - Annual water and sewer costs become unaffordable in FY21 (4.0 percent) for 39% of all households (annual income of approximately $30,000). These costs represent 5.3 percent of annual income for 39% of households in FY30.
    - Annual water and sewer costs become unaffordable for 28 percent of the City's census tracts by FY22 (representing approximately 22.7 percent of the City's population including 24.6 percent of families).
    - For the 26 percent of the City's population (165,000 people) that live below the federal poverty line, the annual water and sewer costs represent 4.7 percent of

income in FY14. Customers will spend approximately 8.8 percent of their annual income on water and sewer by FY30.

- The annual water and sewer costs are already unaffordable for the 77,000 people currently living below 50 percent of the federal poverty line, and account for over 7.7 percent of their income.
- 33% of all households (including 25 percent of families) will be spending 4.0% of annual income on water and sewer costs in FY17.

These results are summarized in Figure 7.10**,** Figure 7.11**,** Figure 7.12**,** Figure 7.13**,** Figure 7.14, and Figure 7.15. Figure 7.12 and Figure 7.15 are maps depicting the City's census tracts and their unique affordability status at the end of the forecast period. A red census tract district is unaffordable based on its individual MHI.

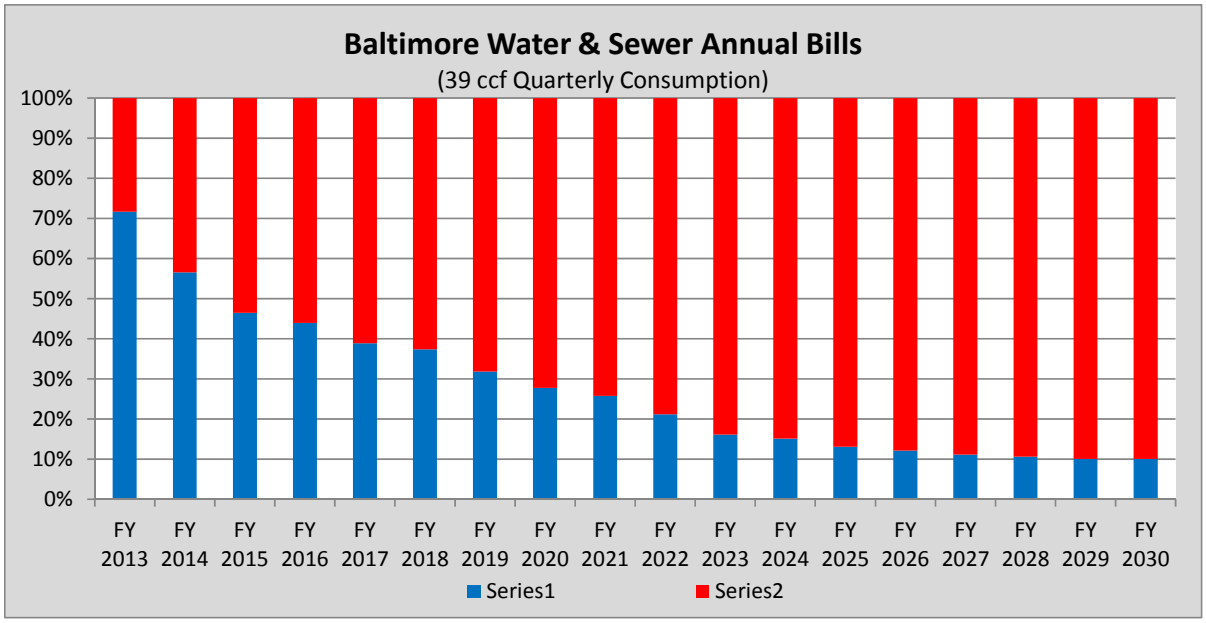


Figure 7.10. Scenario 1B Water and Sewer Affordability at 39 ccf/quarter

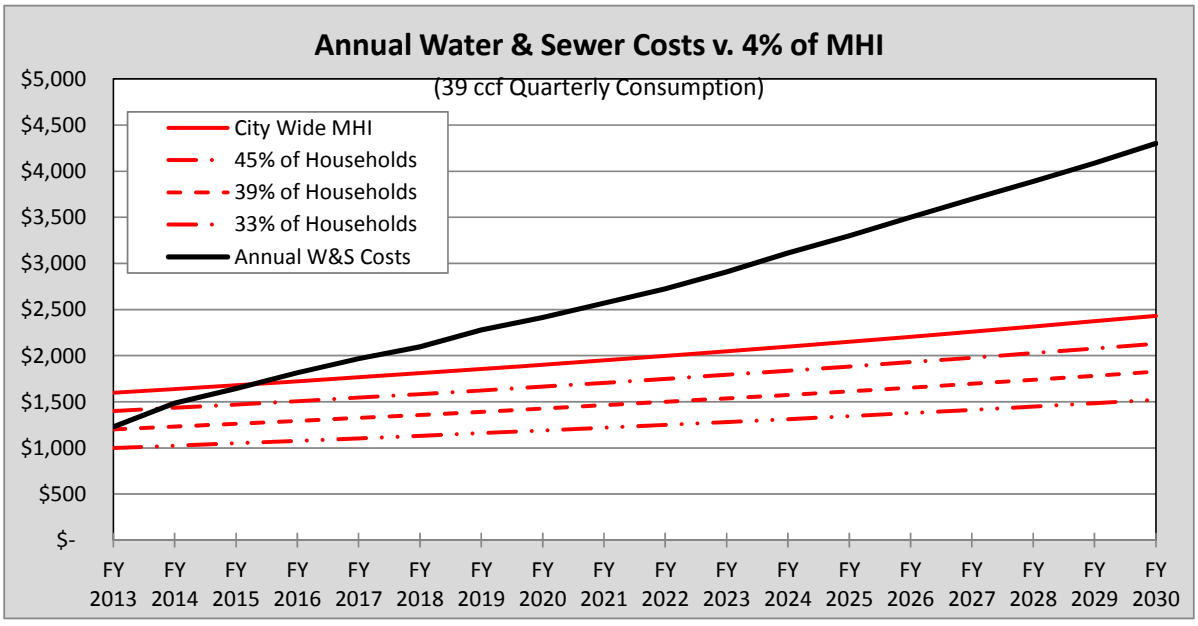


Figure 7.11. Scenario 1B Costs Compared to 4% of MHI for Population Percentages

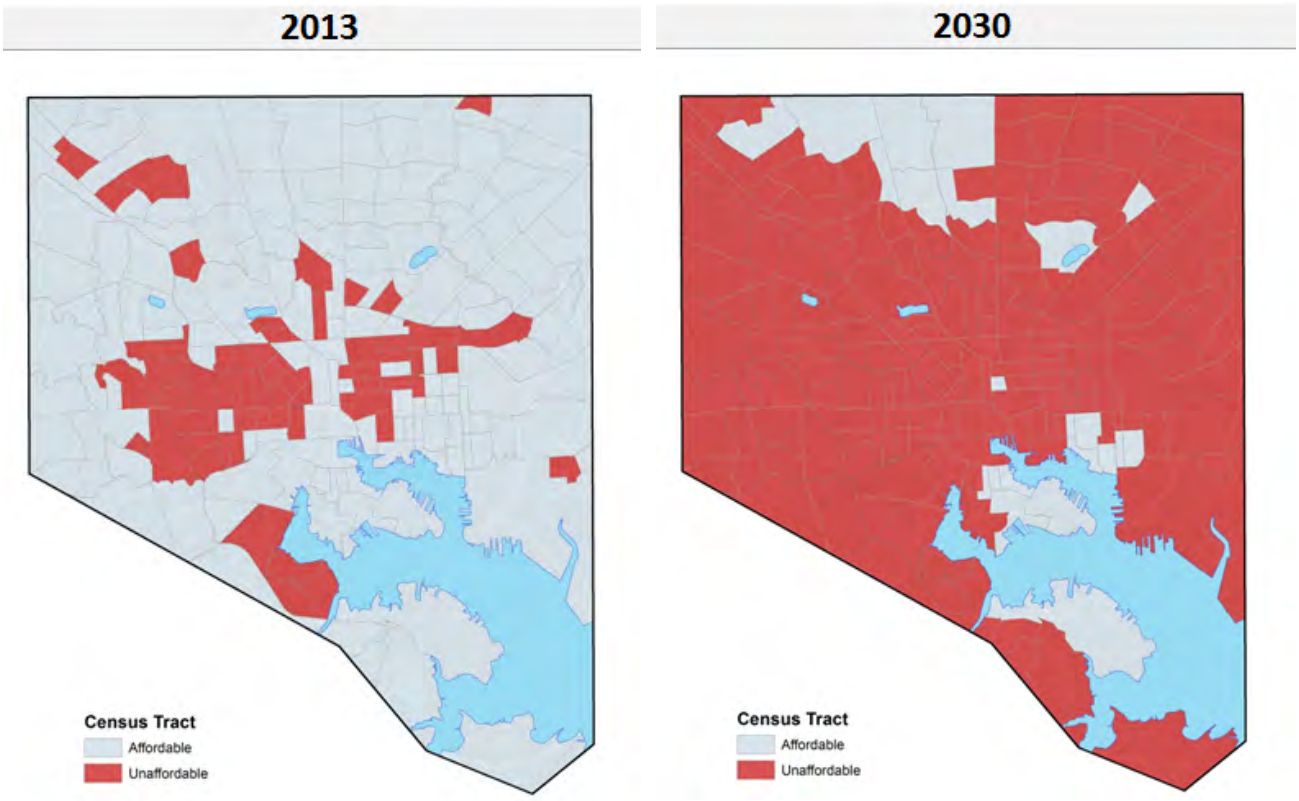


Figure 7.12. Affordability of City Census Tracts at 39 ccf Quarterly Water Consumption – Scenario 1B

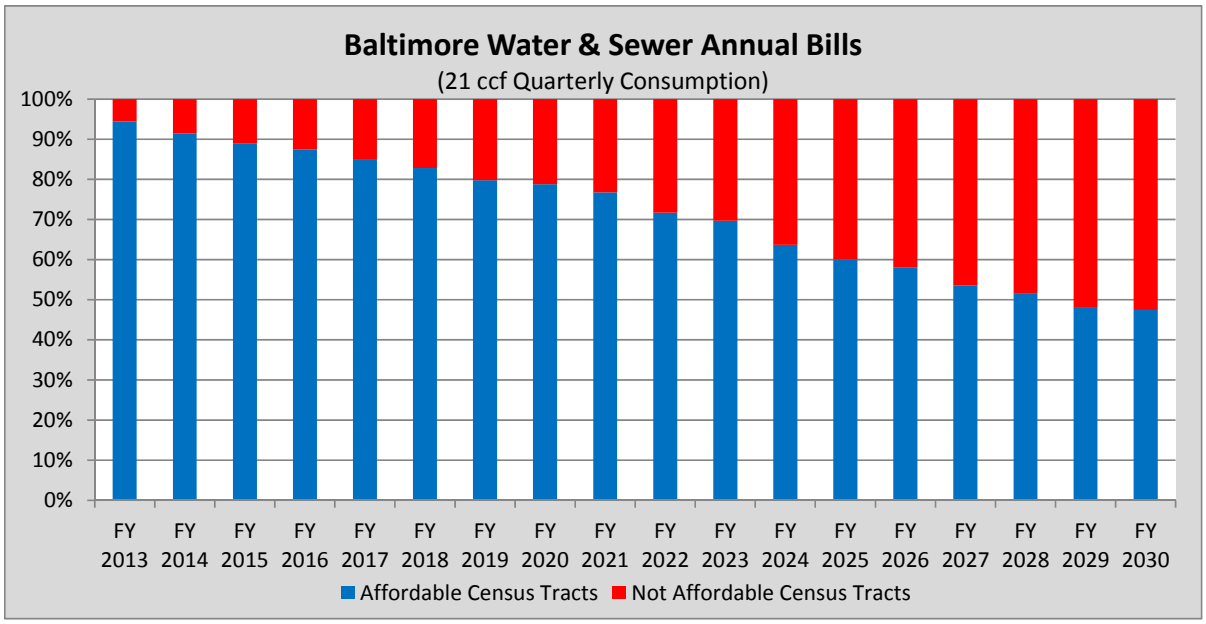


Figure 7.13. Scenario 1B Water and Sewer Affordability at 21 ccf/quarter

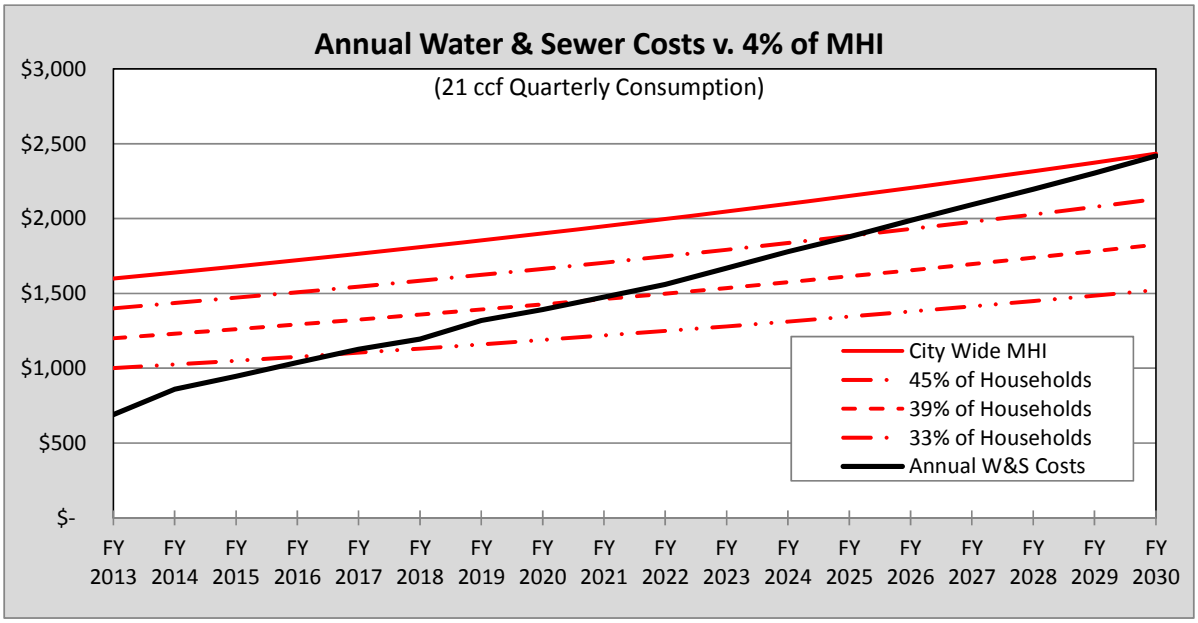


Figure 7.14. Scenario 1B Costs Compared to 4% of MHI for Population Percentages

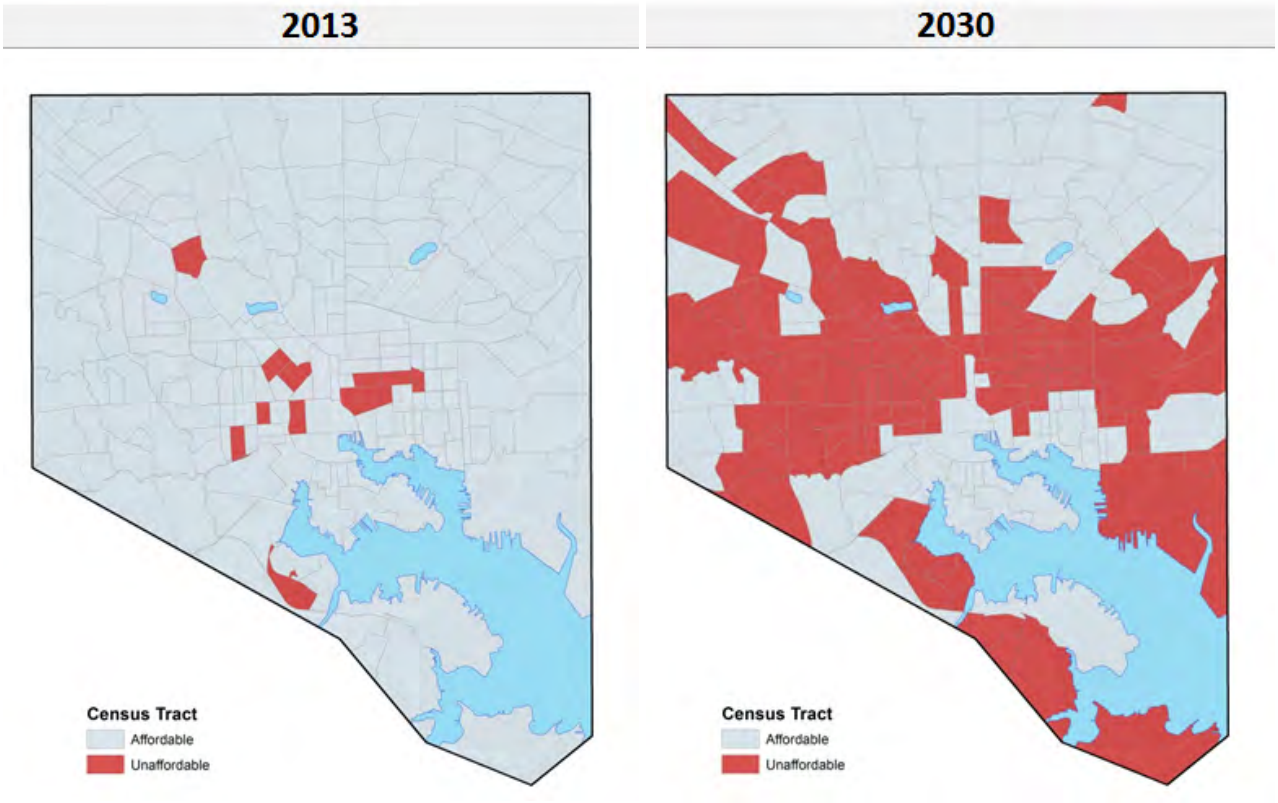


Figure 7.15. Affordability of City Census Tracts at 21 ccf Quarterly Water Consumption –Scenario 1B

7.7 Financial Analysis Impacts on Project Scheduling

Based on the financial analysis, the proposed year-by-year plan to complete each of the prioritized projects in the IPF Project List are shown in the series of figures that follow.

Based on the IPF Project List scores, importance weighting factors and financial analysis, anticipated spending schedules for each scenario were generated. Figure 7.16. Project Annual Spending – Scenario 3, Regulatory (Status Quo) and Figure 7.17. Project Annual Spending – Scenario 1B present the anticipated spending schedules for each of the two primary scenarios evaluated in this IPF report (Regulatory and Scenario 1B).

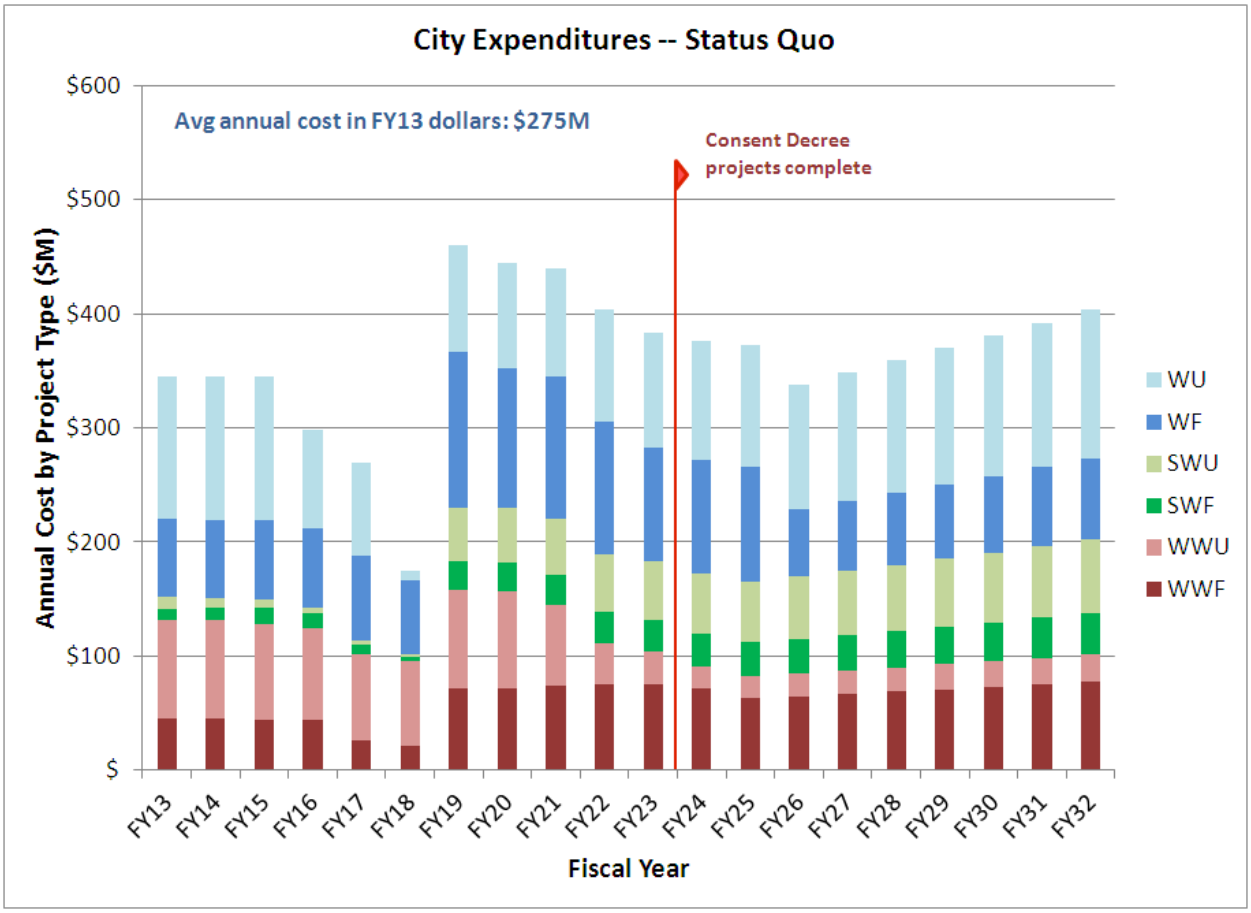


Figure 7.16. Project Annual Spending – Scenario 3, Regulatory (Status Quo)

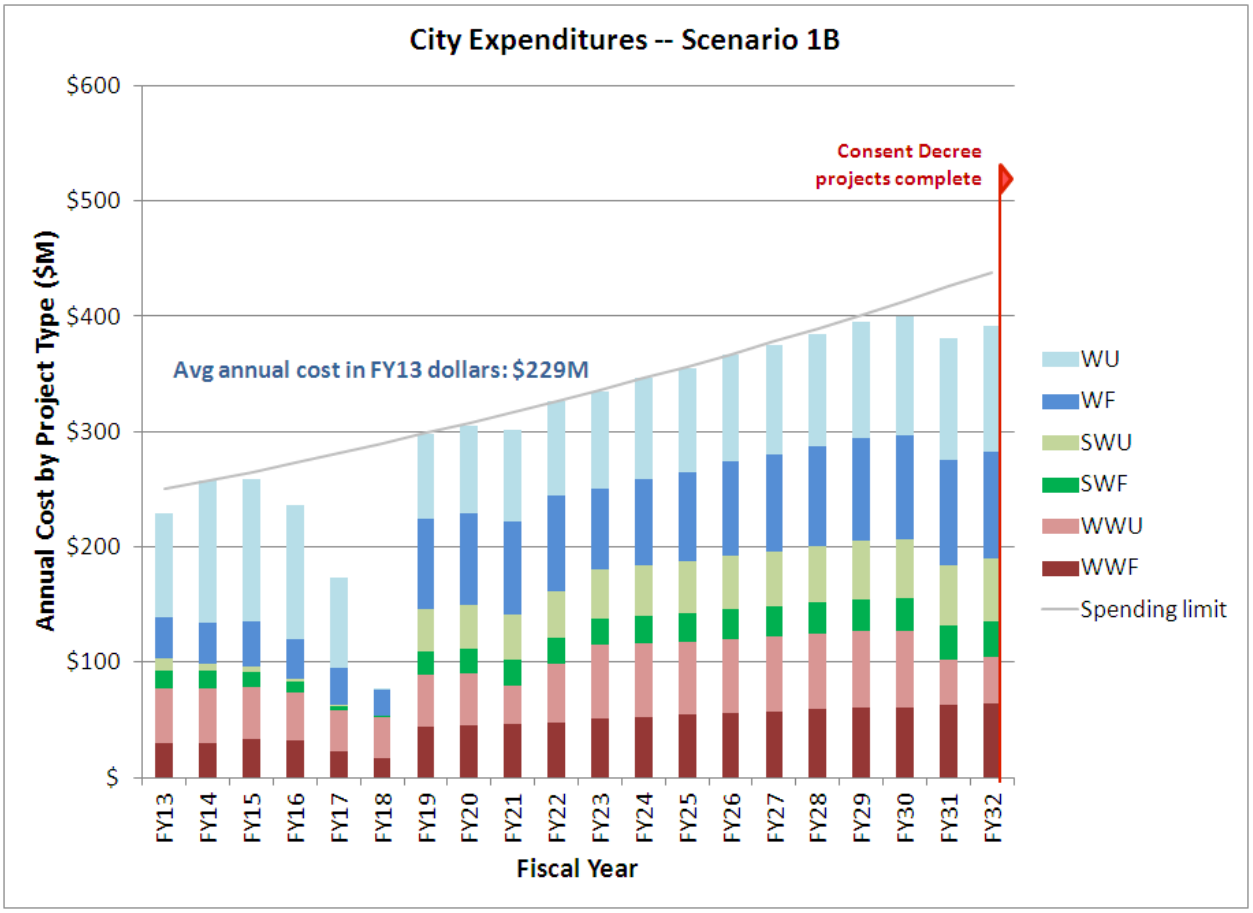


Figure 7.17. Project Annual Spending – Scenario 1B

Financial analysis of the prioritized project list demonstrates that the City will complete all of the regulatory-driven prioritized projects in the IPF project list by 2032. The Consent Decree requires that none of the sewershed plan schedules are to extend beyond January 1, 2016, although EPA and MDE are contemplating an extension. The results of the City's IPF demonstrates that there is the potential for a Consent Decree extension to provide sustainable and affordable water, wastewater and stormwater services to the citizens of Baltimore. Figure 7.18 presents the Scenario 1B anticipated project schedule.

Figure 7.18. Anticipated IPF Project Schedule – Scenario 1B

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
SWF	525-405	ER4023 Biddison Run Environmental Restoration Project 2 (3030 ft length upstream of Moravia to Sipple Ave, 3,850 ft length - Sipple Ave to Sinclare Lane)	0.67	$3.08																				
SWF	525-NEW	Stream Restoration TBD	0.64	$5.30																				
SWF	525-NEW	Moores Run Environmental Restoration Projects	0.60	$5.19																				
SWF	525-NEW	Chinquapin Run Environmental Restoration Projects	0.60	$3.45																				
SWF	525-NEW	Stony Run Environmental Restoration Projects	0.54	$4.00																				
SWF	525-405	ER4018 Powder Mill Run	0.53	$1.50																				
SWF	NEW	Representative Recurring Project: Outfalls	0.50	$796.62																				
SWF	525-NEW	ER4031 Franklin Town Blvd Culvert Stream Restoration (2400 ft including 452 ft tributary)	0.50	$1.22																				
SWF	525-405	ER4028 Western Run Environmental Restoration Project 2 (Kelly Ave - 1000 ft)	0.45	$1.22																				
SWF	525-NEW	Urban Watershed Retrofit Projects Back River WS	0.45	$1.68																				
SWF	525-NEW	Urban Watershed Retrofit Projects Direct Harbor WS	0.44	$6.72																				
SWF	525-NEW	Urban Watershed Retrofit Projects Gwynns Falls WS	0.44	$3.36																				
SWF	525-NEW	Urban Watershed Retrofit Projects Jones Falls WS	0.44	$3.36																				
SWF	525-NEW	Facility Greening Projects Gwynns Falls WS	0.44	$1.29																				
SWF	525-NEW	Facility Greening Projects Jones Falls WS	0.44	$1.72																				
SWF	525-NEW	Facility Greening Projects Back River WS	0.44	$1.72																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Gwynns Falls WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Back River WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Jones Falls WS (300 inlets)	0.44	$0.44																				
SWF	525-NEW	At-inlet Debris Collection / Catch Basin Inserts Project Direct Harbor WS (600 inlets)	0.44	$0.88																				
SWF	525-NEW	Facility Greening Projects Direct Harbor WS	0.44	$3.44																				
SWF	525-NEW	In-line Debris Collection System Projects Gwynns Falls	0.38	$1.74																				
SWF	525-NEW	In-line Debris Collection System Projects Direct Harbor WS	0.37	$2.32																				
SWF	525-NEW	In-line Debris Collection System Projects Jones Falls	0.37	$1.16																				
SWF	525-449	ER4016 Bush Street Debris Collector	0.36	$3.05																				
SWF	525-NEW	ER4034 Biddison Run Debris Collector Project 1	0.35	$0.70																				
SWU	520-NEW	Patapsco Avenue Drainage Improvement	0.44	$4.52																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
SWU	NEW	Representative Recurring Project: Conveyance	0.44	$1420.06																				
SWU	520-NEW	North Point Road Drainage Improvement	0.44	$4.48																				
SWU	520-NEW	2300 Block Seamon Ave	0.44	$0.30																				
SWU	520-400	Pulaski Highway Drain and Inlet Rehabilitation	0.44	$0.43																				
SWU	520-093	Race Street Box Culvert	0.39	$3.50																				
SWU	520-708	Storm Water Pumping Station Improvements Highland Town	0.38	$1.63																				
SWU	520-715	Northeast Baltimore Drainage Improvements	0.38	$3.20																				
SWU	NEW	Harris Creek Storm Drainage	0.37	$6.59																				
SWU	520-451	Fairmount Storm Drain Improvements	0.35	$1.85																				
SWU	520-NEW	Public Storm Drain System Hydraulic Modeling and Asset Management	0.28	$4.00																				
WF	557-928	Urgent needs - Water Facilities Engineering	0.55	$0.75																				
WF	NEW	Representative Recurring Project: Reservoirs & Tanks	0.52	$173.18																				
WF	NEW	Preventive Maintenace Program	0.50	$3.00																				
WF	557-573	Raw water Tunnel Inspections	0.50	$0.50																				
WF	557-709	Finished Water Improvements - Montebello 2 FW Reservoir	0.47	$8.69																				
WF	557-713	Finished Water Improvements - Towson FW Reservoir	0.47	$3.47																				
WF	NEW	Representative Recurring Project: Montebello Preliminary/Settling Upgrade $35M	0.47	$126.75																				
WF	NEW	Representative Recurring Project: Ashburton Preliminary/Settling Upgrade $25M	0.45	$156.15																				
WF	557-300	Representative Recurring Project: Montebello Generator $15M	0.45	$48.96																				
WF	NEW	Representative Recurring Project: Montebello Chemical Systems Upgrade $35M	0.43	$123.94																				
WF	NEW	Representative Recurring Project: Montebello 1 Membrane Filteration $60M	0.43	$331.02																				
WF	NEW	Representative Recurring Project: Ashburton Generator $10M	0.43	$57.67																				
WF	557-730	Fullerton Water Filtration Plant WC 1169	0.43	$182.25																				
WF	557-068	Pretty Boy Reservoir - Roads & Culvert repair	0.42	$6.74																				
WF	557-068	Liberty Reservoir - Roads & Culvert repair	0.42	$3.32																				
WF	557-501	Montebello Water Filtration Plant Laboratory Facilities	0.41	$6.81																				
WF	557-927	Ashburton Chemical Laboratory	0.41	$2.38																				
WF	557-068	Loch Raven - Roads & Culvert repair	0.41	$3.96																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WF	557-924	Pikesville Pump Station Rehabilitation	0.40	$0.00																				
WF	557-926	Towson Pump Station Rehabilitation	0.40	$0.10																				
WF	557-922	Vernon Pump Station Rehabilitation	0.40	$11.13																				
WF	557-923	Cromwell Pump Station Rehabilitation	0.40	$7.12																				
WF	NEW	Representative Recurring Project: Inspection/Maintenance of PS'S	0.39	$742.45																				
WF	NEW	Water Recycling and Solids Handling - Ashburton	0.39	$12.83																				
WF	NEW	Staffing Needs	0.39	$0.50																				
WF	557-715	UV disinfection - Ashburton FW Reservoir	0.38	$31.31																				
WF	NEW	Representative Recurring Project: Pumping Stations	0.37	$346.36																				
WF	557-920	Maint Bldg. Impr. At Loch Raven Dam	0.36	$7.08																				
WF	557-158	Earthen Dam Improvement Program WC-1127	0.35	$3.69																				
WF	557-709	Finished Water Improvements - Guilford FW Reservoir	0.31	$19.96																				
WF	557-727	Deer Creek Pumping Station Improvements	0.30	$6.54																				
WF	557-917	Guilford Pumping Station Rehabilitation WC 1120	0.29	$9.46																				
WF	NEW	Personnel training in Electrical and Instrumentation certification.	0.26	$0.30																				
WF	NEW	Montebello Washwater Lake Dredging & Remediation	0.24	$13.90																				
WF	NEW	Representative Recurring Project: Ashburton Recycle Facilities $30M	0.04	$185.61																				
WU	557-101	Water Mains - Installation	0.62	$10.11																				
WU	557-687	Large Main Rehab & Replacement, PCCP	0.61	$0.15																				
WU	NEW	Water Main Rehabilitation and Replacement in Identified Areas	0.61	$22.91																				
WU	NEW	Large Main Rehab & Replacement, cast iron and steel	0.60	$21.28																				
WU	557-100	Water Infrastructure Rehabilitation	0.57	$329.32																				
WU	557-689	Urgent Needs Water Engineering Services	0.52	$4.72																				
WU	557-031	Water Distribution System - Improvements	0.47	$13.49																				
WU	NEW	Leak Detection & Rehab – Large mains	0.44	$1.50																				
WU	NEW	Large Valve Replacement	0.36	$2.94																				
WU	557-002	Water Utility Billing System	0.36	$12.50																				
WU	557-133	Meter Replacement Program	0.34	$98.93																				
WU	557-400	Valve and Hydrant Exercising - Annual	0.33	$0.74																				
WU	557-638	Water Audit	0.33	$9.55																				
WU	NEW	SCADA Upgrades	0.32	$7.10																				
WU	557-130	Water System Cathodic Protection	0.30	$4.96																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WU	NEW	Representative Recurring Project: Pipelines/Distribution System	0.00	$2859.35																				
WWF	551-528	Patapsco ENR Denitrification and Nitrification	0.41	$11.67																				
WWF	551-689	Back River WWTP Primary and Influent Facilities Rehabilitation SC-918	0.39	$56.20	CD	CD	CD	CD	CD	CD														
WWF	551-687	Patapsco Chlorine Conversion SC-857	0.28	$1.36																				
WWF	551-752	McComas Street PS/FM Upgrade	0.26	$1.63																				
WWF	551-755	Pump Station Force Main Improvements, various locations	0.25	$9.64																				
WWF	551-533	SCADA System Upgrades, Var. Pumping Stations	0.25	$0.40																				
WWF	551-585	Pat LOX Plant Upgrade SC-868	0.23	$1.36																				
WWF	551-561	Back River Settling Tanks	0.23	$2.19																				
WWF	551-526	Back River Digester Renovation SC-8526	0.19	$24.68																				
WWF	551-692	Patapsco Electrical System Upgrade	0.19	$21.86																				
WWF	551-692	Back River Electrical System Upgrade	0.18	$18.43																				
WWF	551-533	Back River Facilities Improvements	0.17	$3.38																				
WWF	551-685	Back River Scum & Grease System	0.16	$2.77																				
WWF	551-533	Annual Facilities Improvements	0.16	$4.50																				
WWF	NEW	Optimization of Inventory Control	0.16	$2.33																				
WWF	551-681	WW Facilities Security Improvements	0.16	$1.00																				
WWF	NEW	Redundancy Systems for Pump Stations/Force Mains	0.14	$3.26																				
WWF	551-533	Patapsco Facilities Improvements	0.13	$7.62																				
WWF	NEW	Expansion of Co-Gen Facility (4th Boiler Given Price Natural Gas)	0.11	$1.23																				
WWF	NEW	Representative Recurring Project: Patapsco Green Energy $15M	0.06	$27.27																				
WWF	NEW	Representative Recurring Project: Patapsco Chemical Facilities Upgrade $10M	0.06	$19.57																				
WWF	NEW	Representative Recurring Project: Back River Green Energy $15M	0.06	$42.61																				
WWF	NEW	Representative Recurring Project: Patapsco Hypochlorite Generation Facility $25M	0.05	$44.40																				
WWF	NEW	Representative Recurring Project: Back River Sludge Storage Facility $25M	0.05	$71.01																				
WWF	NEW	Representative Recurring Project: Back River Hypochlorite Generation Facility $30M	0.05	$83.16																				
WWF	NEW	Representative Recurring Project: Patapsco Pelletization Facility Upgrade $40M	0.04	$71.95																				

Project Type	CIP Number	Project	Total Weighted Score	Total Cost in Study Period to City (M)	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
WWF	NEW	Representative Recurring Project: Patapsco Secondary Treatment Upgrades $50M	0.04	$97.03																				
WWF	NEW	Representative Recurring Project: Patapsco Sludge Digestion Facilities $50M	0.04	$80.22																				
WWF	NEW	Representative Recurring Project: Back River Pelletization Faciltiy Upgrade $60M	0.03	$170.09																				
WWF	NEW	Representative Recurring Project: Back River Egg-Shaped Digester Additions $75M	0.03	$234.26																				
WWF	NEW	Representative Recurring Project: Back River Secondary Treatment Upgrades $75M	0.03	$234.26																				
WWF	NEW	Representative Recurring Project: Pumping Stations & Force Mains	0.02	$519.54																				
WWU	551-627	Wet Weather Program Operation and Management	0.71	$8.70	CD	CD	CD	CD																
WWU	551-410	Herring Run Interceptor improvements	0.59	$3.81																				
WWU	551-611	Low Level Sewershed Improvements	0.58	$83.21	CD	CD	CD	CD	CD	CD	CD	CD	CD											
WWU	551-616	Patapsco Sewershed Improvements	0.56	$20.78	CD	CD	CD	CD	CD	CD	CD	CD												
WWU	551-622	Gwynns FallsSewershed Improvements	0.56	$77.07	CD	CD	CD	CD	CD	CD	CD	CD												
WWU	NEW	Sanitary Sewer Interceptors, Siphon And Right of Way Cleaning	0.54	$27.50																				
WWU	551-612	Outfall Sewershed Improvements	0.53	$109.07	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD									
WWU	551-626	Jones Falls Sewershed Improvements	0.50	$114.23											CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
WWU	551-624	Herring Run Sewershed Improvements	0.47	$235.35										CD	CD	CD	CD	CD	CD	CD	CD	CD		
WWU	551-609	SW Diversion Pressure Sewer Improvements	0.45	$13.48																				
WWU	551-620	High LevelSewershed Improvements	0.44	$82.82												CD	CD	CD	CD	CD	CD	CD	CD	CD
WWU	551-404	Improvements/Rehab of Existing Sanitary Sewer	0.43	$3.88																				
WWU	551-614	Dundalk Sewershed Improvements	0.42	$9.58											CD	CD	CD	CD	CD	CD	CD	CD		
WWU	551-144	GIS Updates & Mapping Program	0.41	$6.28																				
WWU	NEW	Representative Recurring Project: Collection System	0.40	$517.08																				

8 STAKEHOLDER INVOLVEMENT PLANS

8.1 Stakeholder Plan Objectives

Element 3 in EPA's recommendations for an integrated plan requests a process for involving relevant community stakeholders, particularly the state's NPDES permitting and enforcement agencies, in the planning and selection process. This section addresses the potential pathways for development of a public involvement process that will provide opportunities for "meaningful public input".[22]

"Meaningful involvement"[23] means that:

- Potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health;
- The public's contribution can influence the regulatory agency's decision;
- Concerns of all participants involved will be considered in the decision-making process; and
- Decision-makers seek out and facilitate the involvement of those potentially affected.

The City intends to follow EPA's 2003 public involvement policy and guidelines.[24] There is a range of public involvement options, depending on the desired purpose.[25] Guidance documents provide key steps for planning stakeholder involvement. For integrated plans, the anticipated collaboration model can range from one of information exchange to input on recommendations. Both involve a two-way transfer of information such that data, options, and outputs are provided and exchanged and influential advice/input can be incorporated.

The most important aspect of the Stakeholder Involvement Plan is to clearly define the purpose, goals, and objectives for stakeholder engagement. From this, the City can then define:

- Who needs to be involved;
- What needs to be communicated;
- When does the interaction occur; and
- How does the interaction occur.

In determining *who* needs to be involved, key stakeholders can be identified as those who will be most affected by the integrated plan. This can range from the general public who will be informed of the City's vision and goals to specific, organized stakeholder groups. Regardless of the type of group, the City will need to find out how knowledgeable the group is about these infrastructure issues and *what* additional information will be useful to communicate. *When* to communicate and the frequency of these interactions will depend on the audience. *How* to best

22 U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*, May 2012.

23 U.S. Environmental Protection Agency, *Definitions of the Most Commonly Used Public Stakeholder Involvement Terms*. Available at: http://www.epa.gov/publicinvolvement/definit.htm.

24 U.S. Environmental Protection Agency, *Public Involvement Policy of the U.S. Environmental Protection Agency*, May 2003. Available at: http://www.epa.gov/policy2003/policy2003.pdf.

25 U. S. Environmental Protection Agency, *Public Involvement and Collaboration Spectrum*. Available at: http://www.epa.gov/publicinvolvement/pdf/spectrum.pdf.

communicate can range from electronic media (emails, web portals, etc.) to workshops and one-on-one meetings.

The following provides an overview of the City's stakeholder plan. Also see the stakeholder diagrams in Appendix G, Stakeholder Diagrams.

1. Who to target:
    a. Begin with other City entities (departments, divisions, groups and elected officials) to explain the purpose of the IPF and to receive immediate feedback on their concerns and potential mission overlap.
    b. Sequence regulatory agencies, starting with the state NPDES permitting agency (MDE), focusing on obtaining additional data or information to confirm or, if needed, expand the City-defined needs (as defined in Section 4, Utility Challenges, of this IPF report).
    c. Brief elected officials. While the Mayor is already well-aware of the integrated planning effort thanks to her participation in the U.S. Conference of Mayors Water Council, other elected representatives such as City Council members and State and federal legislators will be interested in the impact of IPF on water and sewer rates and the timing of projects in their districts.
    d. Expand to targeted environmental interest groups, including the City's Sustainability Commission. The City will start with environmental interest groups that already have a working relationship with the City and expand the list as needed.
    e. Brief community groups. This effort will be similar to and conducted generally simultaneously with, the targeted environmental interest group activities. The community group focus will include additional education-related materials especially for "green" methods and sustainable technologies, approaches and practices. It is expected that the community group outreach efforts will result in a large amount of interest in the impact of the IPF plan on water and sewer rates. An important part of this effort will be to ensure inclusion of lower income citizens in the public outreach and public input events.
2. When:
    a. Began internal City entity briefings in August 2012 and will require periodic contact to update as the IPF progresses.
    b. First briefing of MDE and EPA in September 2012 and will require regular updates as the IPF progresses.
    c. Brief elected officials prior to reaching out to community and environmental groups with regular updates as the IPF progresses.
    d. Begin targeting environmental interest groups within three months of regulatory concurrence.
    e. Begin targeting community groups three months thereafter.
    f. Hold follow-up sessions as part of the subsequent fiscal year CIP development process and leading up to budget and rate hearings and meetings.
3. How to communicate:

a. 1-on-1. Internal City, regulatory agencies, elected officials and some special interest groups will require regular 1-on-1 communications.

b. Small groups. This can follow a guided conversation format where a small group of stakeholders are brought together for briefing and feedback.

c. Larger briefings. These will be the more communication-focused presentations such as fact sheets and information packets once the preliminary decisions are made.

d. Internet/information portal. Continued communication, particularly for topics such as implementation status, measuring success and monitoring results, will be available on a broad basis through the City's internet sites (including www.cleanwaterbaltimore.org). It will be important that this site be maintained to allow the stakeholders to continue to be involved and committed to the IPF activities.

8.2 Regulatory Agency Stakeholder Involvement

Implementation of the City's integrated plan will necessarily involve participation from state and federal agencies. Proactive communication and feedback with these agencies will be a critical aspect for success. To begin the process, the City conducted a joint regulatory briefing with MDE and EPA Headquarters and Region III representatives on September 24, 2012. At that time a preliminary draft of this document was being prepared. The City described the IPF methodology that had been used to develop an initial set of prioritized projects and agreed to submit a preliminary draft of this report upon completion. A second briefing is targeted for the end of January or early February 2013.

The City's plan for regulatory stakeholder involvement is outlined in the following broad steps:

- Develop an initial prioritized IPF Project List based on the City's knowledge of environmental, health, customer needs and project delivery, and submit a summary report similar to this IPF report;
- Obtain MDE and EPA input on the prioritization process, particularly on the needs identification as detailed in Section 4, Utility Challenges, of this IPF report;
- Develop procedures for sharing stakeholder input from the targeted environmental interest groups and community groups with MDE and EPA;
- Identify NPDES permit and Consent Decree modifications that that may be necessary to implement the IPF plan;
- Work with MDE and EPA to develop a stakeholder plan for federal regulatory agency involvement; and
- Work with MDE and EPA to accomplish permit and Consent Decree modifications.

8.3 Environmental and Community Stakeholder Involvement

The City will develop a specific stakeholder involvement plan targeted to environmental interest groups and community groups once we have MDE and EPA concurrence on the IPF methodology described herein. It will follow the broad outline described in Section 8.1, Stakeholder Plan Objectives.

9 MEASURING SUCCESS

9.1 Performance Monitoring

Element 5 in EPA's recommendation for an integrated plan includes a process to identify success. This includes a program to address compliance monitoring and ambient monitoring. While the specific monitoring and verification plans are under development, the City anticipates modeling the plans on an adaptive management approach.

In the IPF context, adaptive management means making decisions as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and stakeholder input. Results are used to modify management policy, strategies, and practices."[26] While there are many definitions and nuances of adaptive management, fundamentally, adaptive management defines a process by which new information and changing conditions are incorporated into management efforts. Figure 9.1 is a generalized schematic of the basic steps involved in an adaptive management approach.[27] The iterative nature aligns well with EPA guidelines of the integrated planning framework that encourage use of innovative solutions. This approach provides a structure for evaluation and is the approach recommended by EPA for the Chesapeake Bay Program.[28]

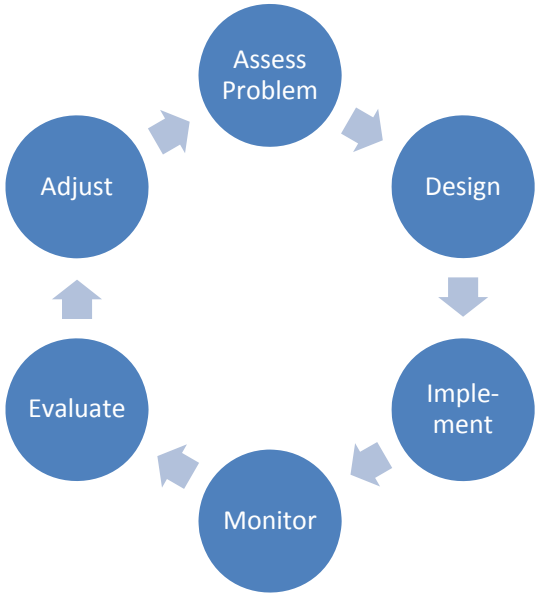


Figure 9.1. Generalized Schematic of Adaptive Management Sequence of Activities

26 "Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management," *Federal Register* 65, No. 202, October 18, 2000, p. 62571.

27 Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

28 EPA, 2008. *"Strengthening the Management, Coordination, and Accountability of the Chesapeake Bay Program"*.

Structured adaptive management approaches incorporate performance factors, such as those required by compliance monitoring, along with stakeholder input. Some of the activities in a structured approach may include:[29]

- Engaging relevant stakeholders;
- Identifying the problem(s) to be addressed;
- Specifying objectives and tradeoffs that capture stakeholders' values;
- Identifying the range of decision alternatives from which actions are to be selected;
- Specifying assumptions about resource structures and functions;
- Projecting the consequences of alternative actions;
- Identifying key uncertainties;
- Measuring risk tolerance for potential consequences of decisions;
- Accounting for future impacts of present decisions; and
- Accounting for legal guidelines and constraints.

As the City develops a plan for measuring success, it will include compliance monitoring and ambient monitoring as well as stakeholder involvement.

9.2 Stakeholder Involvement

Following MDE and EPA concurrence with the IPF methodology described herein, a more detailed stakeholder involvement plan will be developed to include such things as regular updates on the Clean Water Baltimore website, a key contact list and periodic stakeholder meetings. This section will be revised as needed as part of future IPF updates.

9.3 Performance Criteria and Measures of Success

The City already has a foundation for the development of performance criteria. CitiStat is a small performance-based management group responsible for continually monitoring and improving the quality of services provided to the citizens of Baltimore City. CitiStat evaluates policies and procedures practiced by City departments for delivering all manner of City services, from criminal investigations to pothole repair. Staff analysts examine data and perform investigations in order to identify areas in need of improvement. City agencies are required to participate in a highly particularized presentation format designed to maximize accountability. Agencies must be prepared to answer any question raised by the Mayor or her Cabinet at a bi-monthly CitiStat session. Due to its success, the CitiStat model has been adopted by local governments across the U.S. and around the world.

The Bureau reports data on a wide variety of metrics as part of the CitiStat process. These metrics are specific to O&M activities that are tracked in the Bureau's computerized work order management system and are primarily applicable to monitoring each Division's work effectiveness. Unfortunately, these metrics, while necessary to ensure the Bureau is efficiently and effectively providing good customer service, provide only a limited measure of whether or

[29] Williams, B. K., R. C. Szaro, and C. D. Shapiro, Adaptive Management Working Group, *Adaptive Management: The U.S. Department of the Interior Technical Guide*, 2009.

not the IPF projects are producing the benefits predicted in this IPF analysis. The metrics shown below are a subset of the CitiStat metrics that can be used, at least in part, to monitor IPF success. Additional monitoring activities are identified following the CitiStat metric listing.

- Storm Maintenance
  - Water/Wastewater Storm Flooded Street
  - Water/Wastewater Stormwater in Basement
  - Water/Wastewater Storm Mainline Choke
- Water Investigations
  - Water/Wastewater Sewer Leak
  - Water/Wastewater Sewer Water in Basement
  - Water/Wastewater Water Leak (Exterior)
  - Water/Wastewater Water in Basement
- Water Maintenance
  - Water/Wastewater Hydrant Leaking
  - Water/Wastewater-Hydrant Out of Service
  - Water/Wastewater-Water Joint Leak
  - Water/Wastewater-Water Leak To Locate
  - Water/Wastewater-Water Main Break
- Water Quality
  - Water/Wastewater Water Odor/Bad Taste
- Water Supply
  - Water/Wastewater Water Discolored

Additional monitoring parameters that will be used to measure IPF success include:

- Number, and severity, of “boil water” advisories issued
- Number, and severity, of NPDES non-compliance events
  - Plant effluent excursions
  - Annual numbers of wet and dry weather SSOs
- Annual compliance with relevant TMDLs
- Status of compliance with Chesapeake Bay TMDL Watershed Implementation Plan
- Status of compliance with MS4 permit benchmarks

9.4 Pilot Studies

For those innovative and green/gray projects that are anticipated to be included in the IPF prioritization, the City will establish a program for pilot projects that will include specific performance monitoring as part of the project planning process. The results of these pilot projects will be used to determine the effectiveness of the project. Based on these results, the City could:

- Refine pilot project design criteria to be used in future similar projects;
- Revise the benefits scoring assigned to this type of project based on a better quantification of the benefits; and
- Evaluate the cost effectiveness of the project based on life cycle costing and potentially discontinue utilization of this type of project.

10 IMPROVEMENTS TO THE PLAN

10.1 Implementation Activities

The IPF process defined in this report will be implemented in phases. The initial IPF development is described in this report. The next step will be to expand the development process to key stakeholders, with MDE and EPA being the first agencies brought into the plan development. Based on the regulators' input, the City will then engage other stakeholders as described in Section 8, Stakeholder Involvement Plans.

Once the final proposed IPF process is completed, the plan will need to be formally submitted to state and federal regulatory agencies. It is anticipated that the existing 2002 Consent Decree will need to be modified to fully implement the IPF process. The Consent Decree modification process will likely be time-consuming and might require further adjustments to the IPF process. NPDES permits, especially those to be issued in the future, might also need to reflect the decisions made as part of the IPF process, particularly related to implementation schedules.

10.2 Improvement Modifications

Based on the results of key stakeholder input, the modified Consent Decree, future permit implementation schedules and the City's monitoring program from Section 9, Measuring Success, the City will implement a continuous improvement plan for the IPF. This continuous improvement plan will be refined as the implementation process continues, but is expected to include the following components;

- Opportunities for meaningful public input provided on at least an annual basis;
- Annual review of the City's IPF Project List to adjust for changed conditions or scheduling needs;
- Periodic review of the benefits criteria scoring for projects on the City's IPF Project List at least every two years;
- Periodic review of the scoring plans for each benefit criterion to incorporate modifications required by completed performance monitoring results at least every two years;
- Periodic revision of the importance weightings for the benefit criteria based on City and stakeholder input at least every four years;
- Develop a new IPF Project List and Schedule at least every two years;
- Compile documentation and justification to support modifications to the IPF Project List and Schedule required for any Consent Decree or permit modifications; and
- Submit IPF modification requests and supporting justifications to regulatory agencies and negotiate modified Consent Decree terms or permit modification, if needed.

Glossary of Terms, Acronyms and Abbreviations

Adaptive Management: A robust decision-making system that utilizes a continuous process of ongoing scientific evaluations. This involves testing, monitoring and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society.

Affordability Line: The threshold of the maximum amount the rate payers can withstand financially, based on a complex set of factors, where anything greater exceeds the affordability for a certain percent of rate payers.

American Water Works Association (AWWA): A professional organization for the water resources industry.

Asset Management: A structured approach to managing infrastructure assets that enables decision-making about how and when to acquire, maintain, operate, repair, and dispose of or replace assets.

Best Management Practices (BMPs): A collection of either O&M measures or capital facilities designed for pollution prevention. BMPs were first applied by EPA in stormwater regulations, but are now also applied in the wastewater and water areas.

Biochemical Oxygen Demand (BOD): The oxygen required by aerobic organisms, as those in sewage, for metabolism. BOD is a measure of the organic pollution of water. BOD levels in treatment plant effluent discharges are typically monitored in terms of the amount of oxygen, in milligrams per liter of water, absorbed by a sample kept at 20˚C for 5 days, or BOD_5.

Biosolids: The heavier materials that are settled out and removed by the wastewater treatment processes (a.k.a., sludge).

Biological Nutrient Removal (BNR): Removal of total nitrogen (TN) and total phosphorus (TP) from wastewater through the use of microorganisms under different environmental conditions in the wastewater treatment process.

Bureau: The City of Baltimore Department of Public Works' organizational unit assigned the responsibility for operating the City's water, wastewater, and surface water.

Capital Improvement Program (CIP): A formal, prioritized listing of identified capital projects whether funded or unfunded.

ccf: One hundred cubic feet, a measurement of metered water sold to water customers.

Clean Water Act (CWA): The Clean Water Act governs wastewater and stormwater discharges to receiving waters in the United States by issuing NPDES for such discharges.

Closed Circuit Television Inspection (CCTV): Internal inspection technique to determine the internal condition of pipes, particularly sewer mains and water mains, but also where access is possible for private lateral lines and for force mains.

Collection System: An interconnecting system of pipes through which sanitary waste, and in the case of combined systems, stormwater, is collected and delivered to the wastewater treatment plant.

Consent Decree (CD): An judicially enforceable agreement between a municipal jurisdiction, a community, or a private corporation and a regulatory authority which specifies that certain actions will be undertaken by the municipality/community/private corporation within a time frame (at the cost of specific penalties) to remedy an alleged violation of the law.

Debt Service Coverage: The amount of net revenues greater than debt service.

Debt Service Reserve (DSR): Encumbered debt service reserve funds that are equal to, or greater than, the greatest annual debt payment of a utilities' outstanding bond portfolio and that are kept at the utilities trust bank.

Environmental Site Design (ESD): Innovative design principles and technologies used in construction to reduce the stormwater runoff impact to the natural environment.

Facilities: In the context of this report, this term is used to describe permanent or, semi-permanent, municipal properties such as service buildings, water/wastewater treatment plants, or structures (e.g., concrete vaults, manholes), drainage detention basins, buried pipes (water mains, sanitary/storm sewers) built, established, or installed for the performance of one or more specific activities, or functions, such as treatment and supply of potable water, collection of sanitary waste and its treatment and disposal, detaining storm run-off to avoid flooding of populated areas, etc.

Federal Poverty Line: Annual income level for individuals and families determined by the Federal Government to be at or below U.S. poverty level. This is adjusted each year, based on cost of living and often used as a basis to determine eligibility for various federal assistance programs.

Geographic Information System (GIS): Geographical information systems, a data tool that combines mapping with field located features and improvements such as roads, pipelines, buildings and structures, equipment, etc.

Green Infrastructure (GI): Eco-friendly concepts in land-use related to developmental activities implemented to reduce the impact to the natural environment, improve water quality, maintain healthy soils, reduce energy use, and reduce construction costs and operational expenses.

Illicit Connections: Illegal stormwater connections to a separate sewer system.

Inflow and Infiltration (I/I): Extraneous clear water that enters the collection system through direct connections, generally referred to as inflow sources, or through leaks or cracks, generally referred to as infiltration sources.

Infrastructure: Municipal assets servicing the general public such as water supply mains, sanitary sewers, storm sewers, storm drainage detention facilities, water/wastewater treatment facilities, roadways, etc.

Interim ESWTR: Interim Enhanced Surface Water Treatment Rule.

Institute for Sustainable Infrastructure (ISI): A professional organization for sustainable infrastructure.

Low-Impact Development (LID): An environmentally sensitive approach to stormwater management that seeks to manage rainfall where it falls using decentralized, small-scale controls that are integrated into a sites landscape features. The goal of this technique is to mimic a site's predevelopment hydrology by infiltrating, filtering, storing, evaporating and detaining runoff close to its source.

Long-Term 2 Enhanced Surface Water Treatment Rule (LT-2-ESWTR): Refers to the EPA's Enhanced Surface Water Treatment Rule governing treated water quality.

Median Household Income (MHI): The median, which is the value where half of the statistical population is above and half below, income for a household as determined by the U.S. Census Bureau.

Municipal Separate Storm Sewer System (MS4) Permit: NPDES permit issued to a Municipal Separate Storm Sewer System.

National Pollutant Discharge Elimination System (NPDES): The permitting system authorized by the Clean Water Act and administered by the EPA to issue effluent discharge permits for discharges to receiving waters. These permits include wastewater and stormwater discharges.

Operations and Maintenance (O&M): Operations and non-capitalized maintenance.

Pay-As-You-Go, or "Pay Go": The practice of using revenue collected in the present fiscal year for reinvestment in infrastructure in the same fiscal year.

Potable Water: Water that is free from objectionable contaminants and minerals and is considered to be safe for domestic consumption. Also referred to as either treated water or finished water.

Raw Water: Untreated water conveyed from the supply source before it is treated in a water treatment plant.

Revenue Bonds: Special type of municipal bond distinguished by its guarantee of repayment solely from revenues generated by a specified revenue-generating entity associated with the purpose of the bonds, rather than from a tax. Also see Parity Bond and Subordinated Bond.

Safe Drinking Water Act (SDWA): The Safe Drinking Water Act regulates potable water safety in the United States.

Sanitary Sewer Overflow (SSO): Sewage escaping from the collection system or the treatment plant.

Sanitary Waste: Residential and industrial sewage entering the wastewater collection system.

Senior Lien Debt: Debt incurred earliest by a municipality or a corporation and hence takes priority over all other debt. This type of debt is often secured by a collateral (a specific asset) on which the lender has put in place a first lien until the debt is repaid.

Separate Sewer System: Wastewater collection system constructed as a separate network of pipes designed solely to collect sanitary waste.

Sewershed: An area in which sanitary waste is conveyed by a network of small-to-mid size pipes (sewer mains) to a single sewer interceptor (an adequately large sewer main) which ultimately carries said waste to a wastewater treatment plant.

Stakeholder: A person, group, organization or regulatory authority whose interests may be positively or negatively impacted by a project. Stakeholders generally want to influence the outcome of projects impacting them.

State Revolving Fund (SRF): A state fund designed to loan money for infrastructure projects under federal regulations.

Supplemental Environmental Project (SEP): The requirement in the City's Consent Decree to include a study and subsequent design of a treatment process at the Patapsco WWTP that further reduces nitrogen and phosphorus content in the wastewater effluent, thus improving the quality of the effluent discharged into Chesapeake Bay.

Surface Water Management Division (SWMD): A division of Baltimore City Department of Public Works Bureau of Water and Wastewater whose main function is to protect public health and safety through planning, engineering and maintenance of the storm drain system and waterways within the City limits.

Total Maximum Daily Load (TMDL): A calculated maximum amount of pollutants that a water body can receive daily and still meet water quality standards.

Utility Asset Management Division (UAMD): A new Bureau of Water and Wastewater division designed to proactively maintain utility system assets by developing a program and schedule to replace/repair/rehabilitate system infrastructure for the three City utilities (i.e., water, wastewater and surface water).